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MATTHEW LUCKIESH AND FRANK K. MOSS. The Visibility and Readability of Printed Matter

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THE VISIBILITY AND READABILITY OF PRINTED MATTER

MATTHEW LUCKIESH AND FRANK K. MOSS
General Electric Company, Cleveland

A CRITICAL examination of the techniques employed in researches in reading and typography reveals the need for more satisfactory criteria. Fortunately, recent researches in seeing (1) have resulted in the development of some new criteria, devices and techniques which already have been applied successfully to printed matter as a visual task and to reading as a seeing task. In addition, the new approaches emphasize some important inadequacies in the concept of reading as a task and reveal a general neglect of certain factors which greatly influence the visibility of the task. Reading is such a prevalent task of critical near vision that research in this field should have all the aids which new concepts, criteria and techniques can supply. It is the purpose of this paper to present two new approaches which the authors have developed and have successfully used in studies of various aspects and factors of reading as a visual task—*visibility*—and as a task of seeing—*readability*.

VISIBILITY*

Basic Considerations. The term "visibility" is used herein to denote the intensity of a psychophysical stimulus which evokes visual perception and discrimination. By definition, this quantity depends not only upon the efficacy of the visual processes of the observer but also upon the physical characteristics of the object of regard. If it be specified, however, that all measurements of visibility are to be made by observers

* The use of this term in the present sense is now permissible since it has been agreed that the word *luminosity* should supersede the word *visibility* for expressing the relation between luminous flux and radiant flux (2).

possessing normal vision and responses, visibility then, in effect, eliminates the observer as a variable and denotes an attribute of the object of regard. Furthermore, the numerical evaluation of the latter quantity depends upon the adoption of certain specific techniques. For example, it should be evident that (a) all measurements of visibility involve psychophysical thresholds, (b) these threshold conditions may be obtained by varying one or more of at least four fundamental variables of the stimulus, and (c) that the degree of suprathreshold visibility be expressed in terms of some one of these four variables (3). In principle, these inter-related variables of the stimulus possess equal fundamental significance although some one variable may possess certain unique and desirable characteristics from a practical viewpoint.

If an object is visible, it is necessary but not sufficient that the size of the object, its contrast with its background, the brightness of the background and the duration of the image on the retina each exceed certain liminal values (4). The threshold of visibility is obtained with the Luckiesh-Moss visibility meter (1) by simultaneously varying the *contrast* and the *brightness* of the object of regard while the visibility of the object is expressed as being equivalent to that of a so-called "standard" object of elementary geometrical design and of a given *size* under certain specified conditions including particularly the level of illumination and the distribution of brightness in the visual field. Thus the visibility meter serves as a means of determining the equivalence in visibility between (a) a simple standard test-object viewed under specified conditions and (b) any object of regard of any degree of complexity in configuration, brightness-pattern, etc. However, the actual measurement of the visibility of a given object is simplified by calibrating the visibility meter by means of a series of "standard" test-objects which are identical in configuration but which vary in size from the smallest visible to a size indefinitely large. Thus the visibility of any object, after it has been reduced to threshold visibility by means of the meter, may be read directly from the scale of the instrument.

The Luckiesh-Moss Visibility Meter. Our instrument, illustrated in Fig. 1, consists essentially of two colorless circular

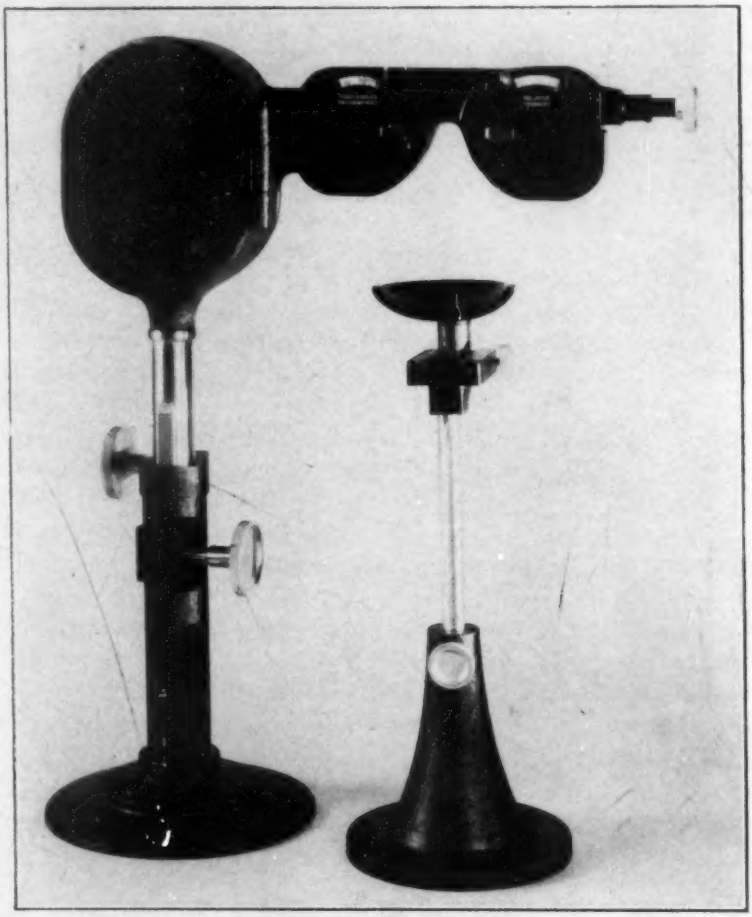

FIG. 1. A laboratory model of the Luckiesh-Moss Visibility Meter.

photographic gradient filters, precise in optical density and diffusion, which may be rotated simultaneously in front of the eyes of the subject while viewing a visual object or while per-

forming a visual task. These gradient filters not only alter the apparent brightness of the visual field due to absorption but also alter the contrast of objects within the visual field due to the slightly diffusing character ("Q"-factor in photography) of the photographic filters. The construction, calibration, operation and precision of the visibility meter have been described in detail elsewhere (1).

The Visibility of Type. The relative visibilities of seven modern faces of 10-point type in common use, as determined by our visibility-meter technique, are given in Table 1. All measurements were made with the printed matter illuminated to a level of ten footcandles and under a suitable and constant distribution of brightness in the visual field. Each value in this table represents the arithmetic average of 5 series of 5 measurements each by each of 15 subjects possessing normal or near-normal vision. As a result of this volume of data, the probable errors of the final averages are of the order of 1 per cent. Each subject was instructed to adjust the visibility meter until he was just able to read (not spell) the printed words. Furthermore, the copy was so placed that the subject did not read the same group of words during each measurement. Thus it may be assumed that such factors as the length, configuration and familiarity of the words read were equalized for all type-faces. Since the effects of progressively increasing fatigue might be a possible source of error, the order of presentation of the samples during alternate tests was reversed. In order to minimize the possibility of error due to inequalities in the printing of these types, three different samples of each face were used during the investigation. An analysis of the three sets of data obtained did not reveal any significant differentials or inconsistencies.

The data obtained by individual subjects are presented in Table 1 in order to permit a study of the precision obtainable with the visibility meter rather than for reason of their intrinsic significance. In general, our experience indicates (a) that the measurements of visibility may be made at a rate of

about five measurements per minute and (b) that the results obtained by trained and untrained subjects are practically identical. It has also been shown (5) that the same relative visibilities of a series of dissimilar objects are obtained by those possessing unusually poor vision as by those possessing normal vision.

TABLE 1

These Measurements of Visibility Were Made at the Usual Reading Distance of 14 Inches and under a Level of 10 Footcandles of Diffuse Lighting. Each Type Was Set with 3 Points of Leading

Subject	A	B	C	D	E	F	G
1	3.16	2.81	3.14	3.14	3.23	2.90	2.98
2	3.45	2.98	3.50	3.65	3.14	3.13	3.13
3	4.46	3.85	4.30	4.56	4.13	3.92	4.05
4	4.01	3.44	3.81	3.75	3.76	3.70	3.76
5	5.20	4.69	5.40	5.55	5.19	4.92	4.95
6	5.46	4.69	5.38	5.53	5.21	5.01	5.06
7	3.53	2.95	3.48	3.26	3.11	3.13	3.30
8	4.14	3.64	4.31	4.18	3.88	4.04	4.07
9	3.32	2.94	3.27	3.27	3.23	3.09	3.25
10	3.17	2.89	3.16	3.23	3.16	2.99	3.10
11	4.99	4.35	5.02	4.91	4.78	4.77	4.91
12	4.86	4.23	5.09	5.26	4.70	4.67	4.53
13	4.82	4.37	5.02	5.13	5.01	4.81	4.90
14	3.93	3.47	3.80	3.89	3.79	3.72	3.95
15	4.39	3.75	4.25	4.56	4.39	4.28	4.50
Average	4.19	3.67	4.20	4.26	4.05	3.95	4.03
Per cent probable error	0.88	0.82	0.73	0.86	0.87	0.88	0.84

The practical significance of the differences in visibility among these 10-point types may be better appreciated by expressing the visibility of each in terms of equivalent type-size as is done in Table 2. The latter data were derived from a previously determined relationship between visibility and type-size (6) for various sizes of Bodoni Book type. For ex-

ample, it will be noted that Type *D* is equivalent to 11.5-point type if Type *B* is taken as a base, although both *B* and *D* are actually 10-point types.

TABLE 2

The Relative Visibilities of the Various 10-point Types Expressed in Terms of Equivalent Type-size. Type B is Assumed as a Base for These Comparisons

Type-face	A	B	C	D	E	F	G
Visibility	4.19	3.67	4.20	4.26	4.05	3.95	4.03
Relative visibility	114.2	100.0	114.5	116.1	110.3	107.6	109.8
Equivalent type-size	11.3	10.0	11.3	11.5	10.9	10.7	10.9

Since reading involves a complex series of visual and mental processes, it is not to be expected that all individuals will respond to typographical characteristics in a quantitatively similar manner. In addition, the processes of measurement are likewise of a complex character. Hence additional information regarding the visual characteristics of these type-faces may be gained from an analysis of the individual measurements of visibility. In Table 3, the seven types have been listed in order of increasing visibility, as determined from the averages of the individual measurements.

TABLE 3

The Numerical Values Refer to the Number of Subjects Indicating a Particular Visibility Rating Per Each of the Seven Types

Visibility Rating (Lowest to Highest)

Type-face	1	2	3	4	5	6	7
B	15						
F		11	4				
G		1	6	5	1	1	1
E		2	4	6	2	...	1
A		1	1	...	5	6	3
C				2	4	6	2
D				2	3	2	8

It will be noted that all of the subjects found Type *B* to be the least visible among these seven type-faces (Type *B* is 8 per cent lower in visibility than Type *F*). The individual ratings of Type *F* are also in close agreement with 11 subjects rating this face as the second lowest in visibility and 4 subjects rating it as third. In contrast to the general agreement with respect to response to Types *B* and *F*, it will be noted that the subjects placed Type *G* in six of the seven rankings, although a large majority assigned it third and fourth places. Obviously, some of this "spread" is due to the fact that the visibility of Type *G* is approximately the same as that of Type *E*. Similar conclusions are indicated for Types *A* and *C*. This ambiguity, due to the small differences in visibility between certain types, may be minimized by the grouping of types of approximately the same visibility as in Table 4.

TABLE 4

Visibility Rating (Lowest to Highest)

Type-face	1	2	3	4	5
B	*15*				
F		*11*	4		
E and G		1.5	*10.5*	2	1
A and C		0.5	1.5	*10.5*	2.5
D			2	5	*8*

It is obvious from Table 4 that the differences in visibility among these types (or groups of types) are not entirely responsible for lack of agreement among the subjects regarding the relative rating of these types. For example, it will be noted from Table 2 that the difference in visibility between Type *F* and either Type *E* or *G* is not as great as that between the latter types and Type *A* or *C*. Notwithstanding this fact, the spread of the data is much less for Type *F*. In other words, the subjects were in good agreement as to the relative "merit" of Type *F;* and in less consistent agreement for the other types. From these considerations, it seems

reasonable to assume that this technique of measuring the visibility of reading matter does include some of the vagaries of the reader which are quite different from those involved in measuring the visibility of single or simple test-objects.

The voluntary reports of the subjects suggest the desirability of measuring the visibility of individual letters as well as the visibility of words or phrases as a whole. For example, one of our subjects remarked that the lower-case "r" of Type *D* was difficult to recognize. Although we place little confidence in such reports, it was evident in this case, that the design of this particular letter was such as to invite comment. It is a well-known fact that the letters of the alphabet vary greatly in their visibilities and, admittedly, it is not practical to equalize these visibilities. However, it is quite possible that further improvements could be made if the visibilities of the individual letters were accurately measured and the design guided by such quantitative data.

Such studies of the visibility of type-faces are necessary if the design of type is to be placed upon a scientific basis. Certainly the differences in visibility among these types (over 16 per cent) are not inconsequential from the viewpoint of providing more favorable conditions for reading, particularly in situations which involve prolonged periods of critical reading under visual conditions which are often unfavorable for seeing. Furthermore when differences in visibility are viewed in terms of other controllable factors, such as type-size, level of illumination, etc., required to equalize various type-faces in visibility, seemingly small differences in visibility assume a greater significance.

READABILITY

Theoretical Considerations. The term "readability" is used herein to express the integral effect of physical factors which influence ease of reading. As such, it includes a consideration of all factors which influence visibility as well as certain other factors whose influence is not appraisable by so-called visibility measurements. Among the latter are typographical

factors such as length of line, leading, margins and others. It will be noted, however, that the concept of readability is not extended to include a consideration of the comprehensibility of the reading matter. In general, a distinction is made between visibility and readability since the criteria for appraising these characteristics do not necessarily involve and measure all possible factors. For example, the visibility of a given line of print is not appreciably altered by the proximity of adjacent lines of print in practical typography while it is a matter of common experience that the ease of reading is markedly influenced by the space (leading) between successive lines (7). Nevertheless, in many cases visibility and readability are closely related. It will be noted that we do not use the term "legibility" which has been widely used in connection with reading matter, generally without clear definition and perhaps never with precise definition. Having applied the term, visibility, rather generally to other visual objects and tasks it was logical to apply it to reading. We then adopted the term, readability, as applying to ease of reading which includes effects of reading upon the reader.

Techniques. We have used the frequency of involuntary blinking as a criterion of ease of seeing or "readability" in diverse researches with consistent results (8). Some of these results are briefly summarized in Fig. 2. It will be noted from these data that the rate of blinking is invariably increased when the visual or seeing task is made more difficult. It will also be noted that this criterion is one of high sensitivity, as is revealed by the large differentials in the frequency of blinking during brief periods and among tasks which are commonly performed in the work-world. In addition, there is considerable evidence from the sciences of physiology and psychology which reveal the significance of this criterion from a fundamental viewpoint of ocular strain and fatigue (9). In brief, this criterion of ease of seeing possesses the advantages of fundamental significance, simplicity in application, and objectiveness and satisfactory precision. Also the results ob-

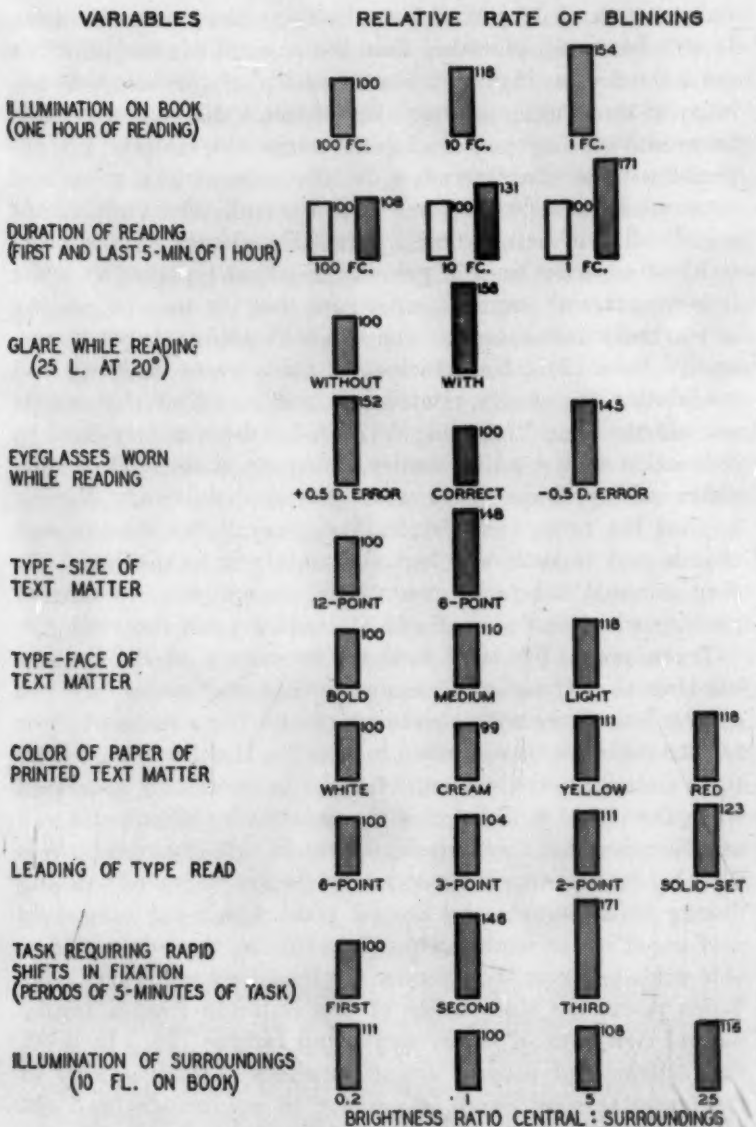

FIG. 2. Changes in the rate of blinking while reading as various factors which influence visibility and ease of seeing are varied individually.

tained with it are in accord with other physiological effects of reading studied by far more tedious and less practicable techniques.

The tacit assumption is often made that the rate of reading should increase as the visibility of the reading matter is increased. Unfortunately, as far as test-procedures are concerned, this assumption is not a valid one in all situations or for all subjects. In some cases, for example, it appears that the subject merely expends less effort in the performance of a given task rather than to increase his production (rate of reading) when visual conditions are improved. Conversely, the rate of reading may be maintained notwithstanding increased difficulty due, for example, to decreased illumination, smaller type, etc. This tendency to compensate tends to make rate of reading an undependable criterion of ease of reading. Furthermore, there is reason for believing that the rate of reading is affected and limited by perceptual phenomena, habits and rhythms in reading more than it is by the physical characteristics of materials now in common use. Although we usually include rate of reading as a criterion in our investigations, it appears that readability is more readily and certainly revealed by involuntary reactions than it is by "performance" over which the subject exercises voluntary control. This conclusion is decisively supported by the results of various researches performed years ago in studies of "production" or rate of doing useful work as influenced by such controllable factors as level of illumination.

The Readability of Type. The present investigation of the factor of type-design (chiefly boldness of types of the same size), as a factor influencing readability, involves a study of Types *B, D* and *G* (Table 1), 10-point in size, and set with three points of leading. These three types were selected from the group of seven type-faces used in the investigation of visibility in view of their range in visibility and apparently, in boldness. Since these modern type-faces do not differ greatly in visibility, it was a fair assumption that the more

elusive characteristic of readability would be ascertainable only by exhaustive measurements. For this reason the number of types studied was limited to three.

The experimental data summarized in Table 5 include (a) the relative visibilities of the three type-faces as determined by 15 subjects, (b) the average frequency of blinking during a 5-minute period of reading, and (c) the average speed of reading during a 5-minute period of reading. The data pertaining to frequency of blinking and speed of reading were determined by 42 subjects, each of whom read each kind of type at two different times, usually many days apart. All observations were made under 10 footcandles of diffuse illumination and suitable and constant brightness distribution in the visual field.

TABLE 5

These Data Are Presented upon a Relative Basis. The Actual Experimental Data Are Summarized in Table 6

	Light (*B*)	Medium (*G*)	Bold (*D*)
Criterion			
Relative visibility	91.1	100.0	105.7
Frequency of blinking	107.5	100.0	91.3
Speed of reading	99.3	100.0	100.1

It will be noted from Table 5 that the frequency of blinking decreased as the visibility (and boldness) of the type increased. Thus it appears that the readability of type is enhanced by increasing its boldness, at least within certain limits which have not been decisively established. This correlation between visibility and readability is an extremely important one since measurements of visibility may be made readily and with considerable precision while the appraisals of readability are tedious. Furthermore, the criterion of visibility yields data which may be interpreted, with respect to visual functions and limitations, upon a quantitative and rational basis.

The appraisal of the relative readability of these three types

by the criterion of speed of reading is less decisive than that of the frequency of involuntary blinking as will be noted from Tables 5 and 6. In these tests the subjects were instructed to read at their normal rate and with their normal attitude toward the text-matter read. The latter was Wells "Outline of Science" and since a total of over 12,000 lines of each kind of type was read during the investigation, it is a statistically safe assumption that variabilities in the nature of the text-matter were equalized among the three sets of copy. This technique for applying the criterion of "speed" of reading is considered to involve normal conditions for reading insofar as "normal" conditions are obtainable in the laboratory. Under these conditions, the criterion of speed of reading usually fails to yield important differentials in situations in which such differentials are indicated by other criteria.

TABLE 6

The Experimental Data with their Corresponding Relative Probable Errors. The Latter Exclude the Systematic Differences which Exist between Subjects. In Computing the Average Values shown Below, the Geometric Mean Was Used in All Cases.

	Light (*B*)	Medium (*G*)	Bold (*D*)
Criterion			
Relative visibility	3.67 ± 0.03	4.03 ± 0.03	4.26 ± 0.04
Frequency of blinking (5-minute period)	25.9 ± 0.65	24.1	22.0 ± 0.59
Speed of reading (lines read in 5 minutes)	134.7 ± 1.05	135.6	135.8 ± 1.17

The asterisks in Table 7 designate that the corresponding type-face was read last in the series of three tests. It will be noted that the frequency of blinking is somewhat higher when the type is read in the third period than it is when the same type is read in the first period. This is an indication of the progressive effects of "fatigue" and the necessity for repeating measurements of this kind in reverse order.

TABLE 7

The Experimental Results Obtained in Two Series of Measurements Which Were Made about a Month Apart

	Light (*B*)	Medium (*G*)	Bold (*D*)
Criterion			
Frequency of blinking			
First series	26.6	23.8	23.1*
Second series	25.2	24.3*	20.8
Average	25.9	24.1	22.0
Speed of reading			
First series	137.0	136.0	133.8*
Second series	132.3	135.2*	137.8
Average	134.7	135.6	135.8

In considering the magnitudes of the differences in frequency of blinking while reading these three types, it will be helpful to review the conditions under which they were obtained. It will be recalled that the period of reading was only five minutes in duration and that the reading was done under favorable environmental conditions by more or less proficient readers possessing normal or near-normal vision. Furthermore, each subject was permitted to read at his normal rate and with his normal attitude. These conditions may be contrasted with that of proof-reading, as an extreme case, which demands a high degree of attention to details of the task for extended periods of time. It is also conceivable that even greater differences would be obtained if less proficient readers, such as children, had been used as subjects. In view of these and other obvious considerations, it seems reasonable to conclude that the differentials shown in Table 5 indicate actual and important differences in the ease with which the various types may be read—that is, differences in *readability*.

The authors acknowledge their indebtedness to Mr. S. K. Guth and Mr. A. A. Eastman for their part in accumulating these data and to the Mergenthaler Linotype Company of

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PERSONALITY ADJUSTMENT OF COLLEGE STUDENTS AS RELATED TO FACTORS IN PERSONAL HISTORY[1]

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THREE hundred fifty-nine students were classified into three groups on the basis of their scores on the Thurstone psychoneurotic inventory—a well-adjusted group (N = 90) with inventory scores from 0 to 29, an average adjustment group (N = 115) with scores from 30 to 59, and a poorly-adjusted group (N = 154) with scores of 60 and above. Each group was asked to check three personal history questionnaires dealing with (1) familial relationships (62 items); (2) school, play, and subjective experience during the grade school period (67 items); and (3) the same experiences during the high-school period (67 items). Attempts were made to avoid common errors found associated with the questionnaire technique, by acquainting the student with them. In order to separate the students' opinions of desirable factors from the factors actually influencing his life, he was asked to check both. Only the latter are presented here. The percentages of students checking each item present in their histories were calculated for each group. Critical ratios were computed for the differences between the extreme groups for all items on the three questionnaires. The items which significantly differentiated the two extreme groups with respect to adjustment were classified. The most significant of these are presented in Tables I, II and III. The data in these tables and the less significant but persistent trends in the other items of the questionnaire point

[1] This study is a part of a larger program of research on concomitants of adjustment and maladjustment in college students. See: McKinney, F., Concomitants of Adjustment and Maladjustment in College Students, *J. of Abn. & Soc. Psychol.*, Vol. 31, 435–457, 1937.

to the following developmental factors as important in personality adjustment.

1. Students who were given opportunities for responsibilities and freedom to meet them were better adjusted.
2. Students whose parents showed understanding of them and who used the guidance type of discipline rather than domination or no discipline at all were better adjusted.
3. Students whose parents were companions to them were better adjusted.
4. Students whose parents or home was ineffectual for some reason, such as low income, incompatibility, or questionable background, *tended* to be less well adjusted.
5. Students who reported good health and physique were better adjusted.
6. Students who have enjoyed considerable social intercourse and play were better adjusted.
7. Students with a moderate positive attitude toward school were better adjusted.
8. Students objectively oriented and with a good attitude toward themselves during their development were better adjusted.

There is a change from the grade school to the high school in the frequency of some items classified as follows:[2]

1. Social activities, for example: more interest in clothes, smoking, and dancing; and less overt social conflict as fighting and teasing.
2. Independence and self-reliance, for example: more freedom, monetary responsibilities; and less emotional dependence.
3. More interest in the opposite sex.

[2] The following frequencies are not found in the table because the differences between the extreme adjustment groups were not significant for each period. The differences due to age, however, are large. The following percentages concern the well adjusted group for the grade school and high school periods respectively. Ability to dance, 25–75; earning of money, 34–61; pecuniary allowance by parents, 39–51; possession of car, 9–56.

TABLE I

Percentages of Students Checking Familial Items of Personal History in Three Thurstone (Adjustment Score) groups

		Percentages of students checking items. Thurstone score groups—(degree of "maladjustment")			
		Group I (Well-adjusted) N = 90	Group II (Average adjustment) N = 115	Group III (Poorly-adjusted) N = 154	Critical ratio of groups I–III
	Personal history item:	*Per cent*	*Per cent*	*Per cent*	
37.	Frank sex enlightenment	66	33	34	5.09
6.	Opportunities for assuming responsibilities (giving tasks and duties)	91	82	70	4.40
3.	Understanding of child's points of view and moods	78	70	55	3.87
1.	Companionship—doing things together (games and reading)	80	78	58	3.79
4.	Anticipation of child's needs (play, social, training)	87	82	69	3.50
50.	Dominance of family by child	1	8	10	3.42
39.	Criticism in presence of others	22	30	41	3.23
16.	Frequent quarrels and disagreements in family	22	36	40	3.05
56.	Anxiety over child's morals	30	44	49	3.02
5.	Broad attitude toward opinions concerning unimportant customs and views	74	69	56	2.94
52.	Painfully insufficient income	4	4	14	2.78
35.	Shielding child from unpleasant knowledge	44	53	62	2.75
2.	Companionship—inviting discussion	69	66	53	2.53
36.	Insistence upon expressions of behavior when child does not feel that way (respect, admiration)	50	56	65	2.30
7.	Suggestion rather than demands in disciplining	61	56	47	2.14
31.	Punishment administered only after giving reasons	84	76	73	2.09
38.	Freedom increased with age	92	87	86	2.00

TABLE II

Percentages of Students Checking Miscellaneous Items of Personal History During Grade School Period in Three Thurstone (Adjustment Score) Groups

		Percentages of students checking items. Thurstone score groups—(degree of "maladjustment")			
		Group I (Well-adjusted) N = 93	Group II (Average adjustment) N = 119	Group III (Poorly-adjusted) N = 157	Critical Ratio of Groups I–III
	Personal history item:	*Per cent*	*Per cent*	*Per cent*	
5.	Almost perfect physical body	87	66	61	4.97
34.	Strong interest in only one member of opposite sex	2	8	17	4.50
37.	Fear of several teachers	8	22	27	4.20
6.	Several embarrassing experiences in classroom	16	40	38	4.05
56.	Few friends	9	14	27	3.90
62.	Sensitiveness to own physical appearance	19	32	40	3.72
25.	Physical development later than average	9	16	21	3.70
57.	Considerable day-dreaming	32	43	55	3.68
47.	Limited playmates and play with others	12	15	30	3.61
1.	Mild physical defects	12	27	28	3.25
58.	Active participation in one or more extra-curricular activities	67	63	47	3.18
28.	Disturbingly rapid physical change	2	5	11	3.12
12.	Often teacher's pet	22	31	40	3.09
61.	Critical of self	29	39	48	3.08
53.	Association with what some people called "bad companions"	12	18	27	3.07
32.	Insufficient clothes	1	5	10	3.07
63.	Belief that you possess no outstanding abilities	18	28	34	2.91

TABLE II (Continued)

		Percentages of students checking items. Thurstone score groups—(degree of "maladjustment")			
		Group I (Well-adjusted) N = 93	Group II (Average adjustment) N = 119	Group III (Poorly-adjusted) N = 157	Critical ratio of Groups I–III
	Personal history item:	*Per cent*	*Per cent*	*Per cent*	
38.	Health below average	4	12	14	2.91
26.	Use of adult clothes and toilet later than average	3	7	12	2.87
29.	Sensitiveness because of insufficient money	3	8	12	2.87
60.	Sensitiveness to family background	2	7	10	2.86
36.	Speech defects or other nervous habits	5	10	15	2.75
13.	Fear of fights	19	23	33	2.52
48.	Teasing seldom received	52	39	36	2.48
43.	Home duties and responsibility	61	54	45	2.48
		61	54	45	2.48
17.	Frightening religious teachings	4	4	12	2.43
39.	Exceptionally good health	70	62	55	2.42
64.	No extra-curricular activities	14	19	26	2.39
10.	No participation in athletics	19	23	32	2.35
49.	Membership in several gangs and clubs	67	62	53	2.22
4.	Disturbing poor audition	0	2	3	2.20
20.	Beginning of smoking	4	9	11	2.17

4. Increase in certain aspects of introversion, for example: sensitiveness and daydreaming.

The similarities between Tables II and III are more striking than the differences. There are a few items which seem more diagnostic in one period than in another. The following items are more important in separating the two extreme groups in adjustment during the high school period: No. 33 Spontaneity

TABLE III

Percentages of Students Checking Miscellaneous Items of Personal History During High School Period in Three Thurstone (Adjustment Score) Groups

		Percentages of students checking items. Thurstone score groups—(degree of "maladjustment")			
		Group I (Well-adjusted) N = 93	Group II (Average adjustment) N = 117	Group III (Poorly-adjusted) N = 157	Critical ratio of Groups I–III
	Personal history item:	*Per cent*	*Per cent*	*Per cent*	
5.	Almost perfect physical body	90	73	61	5.82
33.	Spontaneity in group	73	58	40	5.46
57.	Considerable day-dreaming	41	58	74	5.33
61.	Critical of self	50	73	80	4.92
62.	Sensitiveness to own physical appearance	27	56	55	4.59
39.	Exceptionally good health	85	64	62	4.29
56.	Few friends	10	15	29	3.97
1.	Mild physical defects	15	19	36	3.93
29.	Sensitiveness because of insufficient money	9	15	27	3.89
54.	Jealousy for brother or sister	4	5	18	3.80
38.	Health below average	2	4	13	3.60
47.	Limited playmates and play with others	10	15	27	3.60
36.	Speech defect or other nervous habit	4	8	17	3.59
4.	Disturbingly poor audition	0	3	6	3.56
17.	Frightening religious teachings	0	1	6	3.56
6.	Several embarrassing experiences	13	25	31	3.54
13.	Fear of fights	8	16	23	3.41
60.	Sensitiveness to family background	5	10	17	3.20
63.	Belief that you possess no outstanding abilities	25	33	42	2.84

TABLE III (Continued)

	Percentages of students checking items. Thurstone score groups—(degree of "maladjustment")			
	Group I (Well-adjusted) N = 93	Group II (Average adjustment) N = 117	Group III (Poorly-adjusted) N = 157	Critical ratio of Groups I–III
Personal history item:	*Per cent*	*Per cent*	*Per cent*	
37. Fear of several teachers	5	15	15	2.74
25. Physical development later than average	12	21	25	2.69
52. Several absorbing hobbies (as collections, or building airplanes, etc.)	58	52	41	2.63
27. Desire for more freedom from parents	31	37	47	2.56
53. Association with what some people called "bad companions"	14	21	26	2.39
45. Often loser in fights	9	12	19	2.31
48. Teasing seldom received	58	44	43	2.31
51. Shocking sex knowledge	9	13	19	2.31
28. Disturbingly rapid physical change	5	7	13	2.28
24. Strong belief in own sinfulness or guilt	15	20	26	2.16
11. Teasing often received	27	32	40	2.15
26. Use of adult clothes and toilet later than average	5	10	12	2.03
58. Active participation in one or more extra-curricular activities	90	87	81	2.03
42. Above average advancement through school grades	47	33	34	2.02
34. Strong interest in only one member of opposite sex	26	28	38	2.00

in group; No. 54 Jealousy for brother or sister; No. 51 Shocking sex knowledge; No. 39 Exceptionally good health; No. 61

Critical of self; No. 57 Considerable daydreaming. For the grade school these items appear more important: No. 34 Strong interest in only one member of the opposite sex; No. 12 Often teacher's pet; No. 20 Beginning of smoking. It is not difficult to speculate why these items are more important for one period than the other.

The above findings are related to similar results in the following published studies: Hardy[3] found *physical factors* including health related to adjustment. Baker and Traphagen[4] report that physical factors are related to adjustment, but less so than other developmental influences. The value of intelligent *discipline* and encouragement of self-care is shown by Myers[5] and Baker and Traphagen[6] in the case of school children, and Reynolds[7] in the case of children referred to a habit clinic. The importance of *companionable parents* in the personality adjustment of the offspring is shown by Myers[8] and Baker and Traphagen[9] for school children, Stagner[10] for college students, and Stevens[11] in the comparison of college students and prisoners. Active participation in *play* was found to be related to adjustment by Baker and Traphagen.[12] Wang,[13] and

[3] Hardy, M. C. Some Evidences of an Inverse Relation Between Health History and Behavior Adjustment During Childhood. *J. of Abn. & Soc. Psychol.*, Vol. 31, 406–417, 1927.

[4] Baker, H. J. and Traphagen, V. The Diagnosis and Treatment of Behavior Problem Children. New York: Macmillan, 1935, pp. 393.

[5] Myers, T. R. Intra-family Relationships and Pupil Adjustment. Teachers College Pub., 1935, No. 651, pp. 115.

[6] Baker and Traphagen, *op. cit.*

[7] Reynolds, B. C. Environmental Handicaps of 400 Habit Clinic Children. *Hospital Social Service*, 1925, 12, 329–336.

[8] Myers, *op. cit.*

[9] Baker and Traphagen, *op. cit.*

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[11] Stevens, G. C. Autobiographical Material Concerning the Childhood Environments and the Effects on the After-adjustment of 100 Recidivists and 100 College Freshmen. *Am. J. Orthopsychiatry*, 1932, 2, 279–303.

[12] Baker and Traphagen, *op. cit.*

Reynolds.[14] Wang[15] and Hardy[16] report friendships as important to personality adjustment. Baker and Traphagen[17] corroborate the results that the individual's attitude toward himself and his attitude toward school work is important in developing a well adjusted personality.

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[13] Wang, C. K. A. The Significance of Early Personal History for Certain Personality Traits. *Am. J. Psychol.*, 1932, 44, 768–775.

[14] Reynolds, *op. cit.*

[15] Wang, *op. cit.*

[16] Hardy, M. C. The Out-of-school Activities of Well Adjusted and Poorly Adjusted Elementary School Pupils. *J. Educ. Psychol.*, 1935, 26, 455–467.

[17] Baker and Traphagen, *op. cit.*

A METHOD FOR ANALYSIS OF THE EFFECTIVENESS OF HIGHWAY SIGNS

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SOME traffic officials feel that the signs used on many of our highways are not as effective as they should be. And certainly, a trip across the United States will demonstrate the difference of opinion which exists as to the most effective method of handling this problem. This paper suggests a method of attacking the problem on a scientific basis and describes its use in a preliminary study which demonstrates its practicability.

The problem often arises in practice in connection with new types of signs or layouts, whose effectiveness must be compared with that of other types. Let us suppose that it has been decided to improve the effectiveness of the destination signs in a certain district. What happens? First some new sign designs are made up. These are set up in sample form, either somewhere on the highway or else just outside the sign shop. The various new layouts usually carry the same words or numerals for better comparison.

Then all those connected with the project come out to take a look at the new designs: First the designer, then his boss, and so on up the line. The designs are viewed from a distance and an opinion is formed by the various individuals as to which layout is most effective. The signs are then viewed at close range, after which a second observation is made from a

* I am indebted for advice and suggestions to Messrs. Kelcey and Reed of the Signal Service Corporation, and Messrs. Halsey and Matson of the staff of the Bureau. Observations were obtained through the aid of the 1939 Fellows of the Bureau for Street Traffic Research and were made possible through the loan of test letters of standard design by the Signal Service Corporation.

more distant position and this time perhaps the first opinion is revised. One thinks the signs are no improvement over the old ones; another thinks one particular layout is a "honey"; and there is a general impasse. So the chief finally picks the one he happens to like best and lets it go at that.

Nothing could demonstrate better the need for some means of gauging or measuring the true effectiveness of destination signs. Now there have been similar problems in other fields which have been pretty well solved. Why not follow a generally similar procedure?

THE GENERAL PROBLEM

The traffic engineer wants to determine the over-all effectiveness of his signs in getting his message across to the motorist. For until the motorist has the message, observance of the regulation cannot be expected of him. Observance depends upon more complex factors and calls for other methods, but the effectiveness of a sign in imparting its information successfully can be analyzed in fairly simple fashion.

FUNDAMENTAL FACTORS IN HIGHWAY SIGN EFFICIENCY

By combing the experience of practical pioneers in the highway sign field with previous experimental work on highway signs (1, 3), and our demonstration technique, we arrived at the following analysis:—

I. *Legibility*
   a. *Pure Legibility*
   b. *Glance Legibility*

II. *Attention Value*
   a. *Target Value*
   b. *Priority Value*

Legibility is a well accepted term indicating the ease with which copy can be read when there are no distracting conditions. In the case of highway signs, the best practical measure of legibility is the distance at which the sign can be read. *Pure Legibility* is the distance at which a sign can be read with unlimited time. This corresponds to the ordinary condition where test signs have been set up outside of the sign shop. *Glance Legibility* is the term used for a similar

reading distance under rapid glance conditions. The most extreme illustration of glance reading is perhaps the plight of a driver in very heavy, rapid traffic who must read a sign as it flicks by in the instant at which it is not obscured by another car. Both of these terms are limited to the readability of the copy itself and can be measured in an experimental set-up.

Attention Value includes all factors which result in attracting the eye to the sign. *Target Value* is applied to the characteristic which makes a sign stand out as different from other objects and other signs. For instance, in one state extremely large "Slow" signs are used near construction projects in order to make these signs stand out from all other signs and objects. *Priority Value* is used to designate the qualities which result in one of the signs of a group being read first, even when all signs are of the same type and therefore have the same target value. On approaching a group of destination signs at a crossroad, which one will the driver read first? The sign which is consistently read first by a large number of drivers may be said to have greatest priority value. Attention values, in contrast to legibility, must be determined under actual road conditions of mounting and surroundings, although fundamental factors may be derived for general application.

If we are signing for through traffic on a high speed route, we desire for our more important warnings the greatest target and priority values. Further, they should have the greatest glance legibility to allow quick reading in order to eliminate excessive driver distraction or slowing down with attendant blocking of traffic.

TECHNIQUES FOR LEGIBILITY MEASUREMENTS

As pointed out above, legibility measurements may be made for various types of letter, spacing, and sign color in an experimental set-up. A preliminary tryout was given such a technique to demonstrate its practicability.

Figure 1 shows the equipment which was used for pure

legibility and glance legibility measurements. It consisted essentially of a universal sign board fitted with racks into which could be slid the test letters. This signboard was 4×6 feet in height and stood 30 inches from the ground. A shutter was devised to be placed a couple of feet in front of the universal

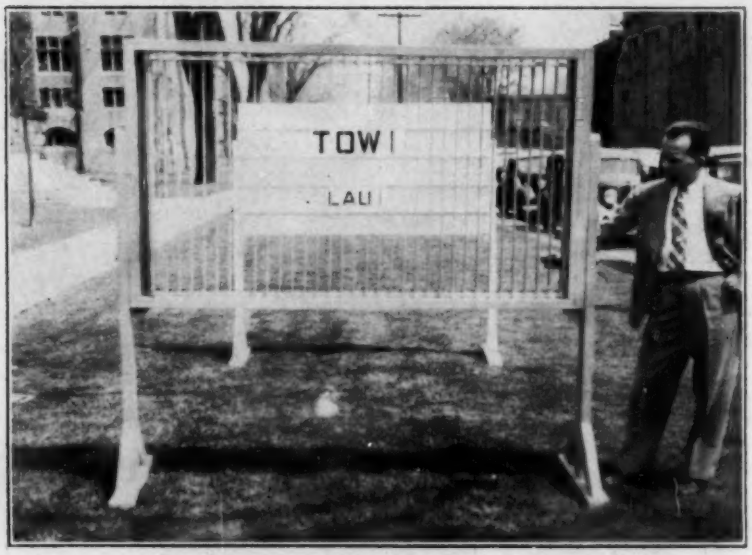

FIG. 1. Test signboard and shutter.

sign board. Thus the different letter combinations could be set up out of sight of the observers.

The shutter consisted of a Venetian blind with the slats mounted vertically instead of horizontally and with a handle attached so that the vanes could be rotated through 90° and thus open to give a clear view of the signboard behind. The fastest manual operation of this device gave an effective exposure of from .2 to .3 seconds since this is the approximate reaction time of a double arm movement. Longer times were timed with a stopwatch. Three exposures were used in the study, *i.e.*, minimum exposure, 1 second, and unlimited time.

Six experimental series of letters were used. These consisted of 2, 4, and 6 inch letters of the standard series B and E.* These letters were black on a white background, and each individual letter was mounted on a metal plate cut to such dimensions that placing plates edge to edge gave a fixed spacing. The signboard background was painted white to match the letter background so that greater spacing could be obtained by spreading the plates, and smaller spacing by overlapping the plates.

PRINCIPLES OF TESTING LEGIBILITY

Certain broad principles for the testing of legibility have been derived by others in connection with work on type-faces and in the testing of vision by means of legibility. These may be summarized as follows:

1. Different observers will read signs at different distances and therefore must not be allowed to influence each other.
2. Enough different observers must be used to get a reliable measure of the differences in eyes which occur among an average group of drivers.
3. Several observations per person are preferable, if possible, in order to overcome accidental factors such as guessing or the misinterpretation of one particular letter.
4. To obtain the true legibility of letters the observers must not know ahead of time what letter combinations are going to be seen.

PROCEDURE

A. *Rapid Practical Procedure*

Distances were marked off in 25 foot units with the signboard as reference point. The letter combinations were set up behind the closed shutter. The observers were stationed in a group at a distance greater than that at which the test letters were legible. When the shutter was opened, the observers then walked up toward the signboard, each man ad-

* As specified in drawings listed in the Manual on Uniform Traffic Control Devices and available through the Bureau of Public Roads, Washington, D. C.

vancing until he was able to read the letter combination exposed. Each observer then recorded this distance and the letters he saw and advanced further to verify the reading which he had given the sign. The first point at which consistent correct reading was obtained gave the legibility distance for the individual.

For Pure Legibility, the shutter was opened and left open continuously until all the observers had reached their legibility distance. For Glance Legibility, 1 second exposures were given at intervals until all observers had reached their own legible distance.

The process was repeated for each letter type and spacing. The new test combination of letters was set up behind the closed shutter, and the observers started again from the distant location toward the sign.

B. *Accurate Procedure*

A more accurate procedure was also used, but this involves the use of an amount of time which is not practical for most purposes. This procedure was similar to the previous one except that after each exposure, whether long or short, the test word was altered. Thus the group of observers moved nearer to the test sign by 25 foot intervals, seeing a different letter combination at each point, until each had reached his own legibility distance. This procedure is more accurate in that each presentation is absolutely new to the observers. However, the cost in time is great and the difference in results for practical purposes negligible. For this reason the more rapid procedure is recommended.

RESULTS ON LEGIBILITY

Nineteen observers only were available for this preliminary study and the results presented are therefore essentially a demonstration of the practical utility of the method. A more extended study has since been carried out jointly with a highway organization and will be reported elsewhere.

A. *Interference from the Shutter*

The interference experienced due to the vertical edges of the gray shutter vanes was slight as indicated in Table 1. Median

TABLE 1

Effect of Shutter

Comparison of Pure Legibility Distance with and without Shutter

Median Legibility Distance for Indicated Letter
19 Observers—6 Letters, Scrambled
Long Exposure—Fixed Spacing

	4″ E	4″ B	2″ E	2″ B
Without shutter	287	205	170	69
With shutter	275	187	120	100*

* This figure is questionable since some observers indicated incomplete observations after the observations were terminated.

legibility distances for the group of observers are here compared with, and without, the shutter in front of the signboard. To obtain the latter condition, the whole shutter was simply moved aside.

It will be noted that there was apparently some slight interference with the 4 inch letters, but it was not of any magnitude with letters of that size or larger. The results on the 2 inch letters indicate that for a test of small letters, the shutter should be removed entirely.

B. *Pure Legibility*

Results on the 2, 4, and 6 inch letters of series B and series E are shown in Table 2 for spacing fixed by the plate widths and for the ½ fixed spacing. Six letter test words or combinations and the more accurate method were used here, *i.e.*, the test letters were changed after each exposure. Each vertical column in the table shows the number of observers who reported correctly the test sign at the distances shown in the left-most column. Thus each column represents a distribution of the reading distance by different people for a given letter and

TABLE 2

Legibility with Long Exposure through Shutter
Fixed (F), ½ Fixed (½F)
Spacing
6 Letters Scrambled—Letters Changed for Each Exposure at Each Distance*

Distance	6″ E		6″ B		4″ E		4″ B		2″ E		2″ B	
	F	½F	F	½F	F	½F	F	½F	F	½F	F	½F
450	2	1										
425	0	1										
400	1	0										
375	4	0										
350	7	5	2	1								
325	2†	3	5	4								
300	1	5	5	4	5	1						
275	1	1†	3	4	5	4						
250	1	3	4†	4†	1	1	1					
225				2	6†	7	2					
200					1	4†	1	2				
175					1	1	9	6	3		1	
150						1	2†	3	4	9	2	
125							4	8†	2	3	2	
100									9†	6†	4	4
75									1	1	9†	15†
50												

* Longest distance at which word was seen correctly by each individual.
† 80 percentile point.

spacing, and the median or middle person might be used as an index of legibility. However, for practical reasons it is desirable to have signs legible to at least 80 per cent of the drivers. Therefore the heavy black numerals in the table enable the reader to perceive the general range of the 80 percentile values, *i.e.*, the distances at which 80 per cent of the observers reported legibility.

In spite of the small number of observers, it will be noted that the wider letters, and the greater spacing of the two used, showed consistently greater legibility. The results suggest

an interesting relationship to the rule of thumb often heard of 50 feet of legibility for 1 inch of letter height. The wider letters (series E) showed somewhat more, the narrower somewhat less legibility than indicated by the rule. Dependable values, however, must await a much larger group of observers in order to obtain a fair sample of eyesight of the driving public.

C. *Glance Legibility*

a. *Time*

The effect of reduced reading time on legibility was demonstrated by reducing the shutter exposure to correspond to a single glance. Six letter combinations of nonsense or scrambled letters were used.

As shown in Table 3, the effect of reducing the seeing time

TABLE 3

Comparison of Pure and Glance Legibility Distances

Legibility Distance Including 80 Per Cent of Observers
Fixed Spacing—6 Scrambled Letters

Letter	4″ E	4″ B
Pure legibility (long exposure)	233	150
Glance legibility, 1 sec. exposure	187	137
Minimum exposure, 0.2–0.3 sec. (approx.)	192	116

to approximately 1 second was to reduce slightly the legibility distance. This reduction appeared in this particular instance to be from 10 per cent to approximately 16 per cent, although again the figures are only suggestive. A further reduction of the exposure to 0.2 to 0.3 seconds' minimum did not further reduce the legibility distance consistently. Other investigators have reported that from 0.1 to 0.3 seconds are necessary for the eye to come to rest and to focus, (2) and another similar interval is necessary for motion of the eye from one point to another. Thus two glances (movement, fixation, movement, second fixation) will require from 0.4 seconds as an extreme minimum to about 1.2 seconds.

b. *Familiarity*

In order to demonstrate the effect of familiarity or recognition value on glance legibility, 3 and 4 letter combinations were presented as indicated in Table 4. The factor of legibil-

TABLE 4

Effect of Familiarity on Number of Words Seen at a Glance

All Observations within Easily Legible Distance (125 ft. using 4-inch series E and 6-inch series B letters) and with Minimum Exposure (approximately 0.2 to 0.3 seconds)

	Unfamiliar		Familiar	
Combination	A	B	C	D
Number of syllables or words in combination	3	4	3	4
Number of syllables or words read				
0		1		
1	5	3	1	4
2	13	12	6	10
3	1	3	12	3
4				2

Combinations

A—HOL WAN TESP
B—LANS THEP WOV WEH
C—SLAP THE POST
D—HAUL PEST NEW STOP

ity was held constant by presenting 4 and 6 inch letters at a distance of 125 feet where both were easily read. The first two combinations were definitely unfamiliar and, as shown in columns A and B, of Table 4, only two of the syllables were seen correctly by the majority of the observers during a minimum exposure. Combination D on the other hand consisted of familiar words but in an unfamiliar order. Although a few individuals saw this more correctly, for the majority of the observers the effect was no better than with the unfamiliar

symbols. Combination C involved familiar words in a familiar order and the majority read all three words.

This constitutes a rough demonstration that in order to produce the most rapid seeing, a sign should contain not more than three familiar words. It should be pointed out here that the use of symbols enhances the glance value by virtue of familiarity and by reducing the amount of text.

ATTENTION VALUES—THE PROBLEM

Now a sign may be quite legible and yet it may not be seen at all simply because the driver has his attention attracted by another object or sign. Or, he may notice it so late that there is not sufficient time to act in response to the warning. Lack of priority value and target value may be said to be responsible.

Let us view an example of the priority value problem. Take for instance the destination signs at a junction on a main route leading to several large cities as well as several smaller intermediate towns. In one jurisdiction the farthest destination will appear at the top and nearer ones in order underneath it. Thus, let us say, Chicago might appear at the top and four or five nearer towns and cities below. In other locations the nearest towns will be found placed at the top. Or again, the major through destination alone appears, or sometimes the through destination and nearest intermediate town.

These various methods are an attempt to obtain *priority value* for the destination, or destinations, which will direct the largest proportions of the traffic and therefore send it through with the least delay.

For an illustration of the target value problem assume a location fitted with standard symbol and warning signs at which the traffic engineer is "shooting trouble." He finds a bad right angle turn on a high speed highway with a number of roadside stands preceding the turn. The turn warning is completely swamped among the stands and their advertising signs.

What happens? Our trouble shooter decides that the warn-

ing sign does not stand out well. In other words, it does not have sufficient *target value.* He therefore may order more signs, a larger sign, or possibly a change of mounting locations, all in an attempt to make the sign stand out and thereby attract attention. Again there seems to be little agreement among engineers as to the effectiveness of different methods.

Analysis of Attention Values

How then may we analyze the factors of effectiveness relating to priority and target values? Although the magazine ad problem is somewhat less complicated, it may furnish us valuable clues. It was found that the attention value of magazine advertisements could be measured by setting up test ads in which the legibility factor was held constant. Other factors such as placement, color contrast, size, and certain special features were varied. A large number of people were then required to leaf through the dummy magazines as if leafing through ordinary commercial magazines, after which they were required to recall or recognize a number of test layouts.

In similar fashion it is possible to use test locations on the highway. In order to test for priority value a nest of similar signs, such as standard destination signs, mounted on the same post, may be used. In order to test for target value, the test locations should be selected where the highway signs must compete with other signs or interesting objects.

A technique of this sort has been tried out in a preliminary way. First a squad of three observers was made familiar with the layout of the test locations and furnished with a means of rapid recording. After this the drivers (who had not been over the route) drove the observers over the test route. The driver's instructions were given in terms of route numbers and destinations as if he were going on a trip through unfamiliar territory. The drivers were instructed to call out all warning, route marker, and destination signs which seemed pertinent to their driving and were told to drive as if they were in a "moderate hurry."

It is important that the driver does not slow down and give greater attention to signs than he would in a normal case. One observer on the front seat was assigned to ask questions and engage the driver in conversation, the latter being instructed to join in as far as permissible in his operation of the car.

The few preliminary observations which have been obtained in this fashion suggest factors of attention which probably operate with highway signs.

PRIORITY VALUE

Under priority value the following factors would be expected to be operative from work by others. The habit of reading from left to right and from top to bottom would be expected to hold and apparently did, as indicated by the fact that the top position showed priority of call in roughly 4 out of 5 cases where all signs were almost identical. (See Figure 2 for a sample layout.)

Prior position on the highway and nearness to other attention compelling objects or signs would also be expected to influence priority value.

TARGET VALUE

Judging from the work on advertisements, it would be expected that relative size, color contrast, location, and the simplicity of message and layout would affect target value.

It is of interest in connection with the question of target value that in a small sample obtained for standard 24 inch symbol warnings, the calls occurred at from 200 to 400 feet from the sign. This contrasts with the 800 or more feet at which the same observers reported *legibility* for similar symbol signs in previous tests. The calls therefore suggest that, at least under conditions of brown bare winter terrain, only about 50 per cent of the legibility distance of the symbol sign is effective, *i.e.*, it is seen only 50 per cent as far, due to lack of target value.

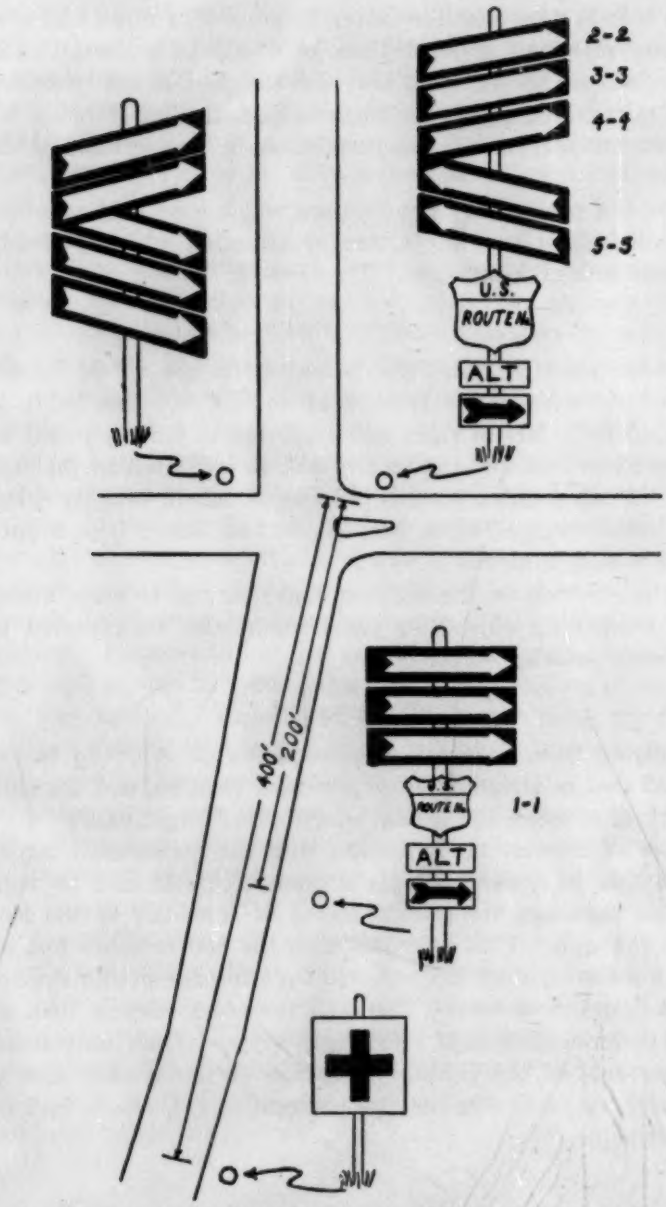

FIG. 2. Sample priority value layout. (Numerals indicate the order in which the signs were called by two drivers.)

Amount and type of reflectorization obviously should be a major factor in night target value (as well as in night legibility).

SUMMARY

(1) A method for the analysis of the effectiveness of highway signs was tried out. Applications to practical shop and field problems were indicated. The analysis was based on the experience of those in the highway sign field, and also previous work by others on the effectiveness of signs and advertisements, with modifications for the present problem.

(2) Sign effectiveness was analyzed into Legibility (pure legibility and glance legibility) and Attention Values (priority value and target value).

(3) Test equipment for the measurement of the two types of legibility was devised. It consisted of a universal signboard with interchangeable letters, and a shutter to allow short presentations of the test signs.

(4) A technique was tried out also for checking the target and priority value of signs in their actual highway location.

(5) Legibility distances were obtained for a small group of observers for standard Series B and E letters for different sizes and spacing. The results showed an interesting relationship to the rule of thumb in use by practical sign experts, but a more extensive study is necessary.

(6) Short time or "glance legibility" distance appeared to be slightly less than the corresponding pure legibility distance for a given letter and spacing.

(7) The increase of glance value from familiarity was demonstrated with 3 and 4 letter combinations. Symbols derive their advantage from simplicity of layout and familiarity value.

(8) It was demonstrated that not more than 3 or, at most, 4 words are seen at a single glance. On high speed highways where rapid or glance legibility is most desirable, therefore, sign text should be limited to this number of words or symbols.

(9) The following factors would be expected to affect target

value; color contrast, relative size, simplicity and contrast of layout (as in the symbol sign), placement and, at night, reflectorization. Certain of these factors were demonstrated.

(10) Factors expected to be fundamental for priority value were reading habits, prior position on the highway, and proximity to another attention compelling sign or object. Observations were suggestive.

(11) The observations were very few in number, but they illustrate the practicability of the approach, *i.e.*, the analysis of the effectiveness of highway signs into fundamental factors which may be measured.

(12) The technique described may be used in the sign yard and on the highway respectively to check in an objective manner the effectiveness of signs and sign installations. A more extensive investigation of the factor of pure legibility has been conducted on a joint basis since this preliminary work and will be reported later. Similar extensive studies of the other factors are to be hoped for.

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THE PERSONNEL TEST: A RESTANDARDIZED ABRIDGMENT OF THE OTIS S–A TEST FOR BUSINESS AND INDUSTRIAL USE*

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INTRODUCTION

THE characteristics most valued in an intelligence test for business and industry are somewhat different from those stressed in academic use. For both purposes, of course, adequate reliability and validity are required. But simplicity of administration and ease and objectivity of scoring become additional important factors in large scale industrial employment. The Otis Self-Administering Test (Higher Form) has become widely used in business and industry because of the very fact that it possesses these latter characteristics. This test, however, standardized and validated upon school children, has been shown to have a number of weaknesses which make it unsatisfactory for adult groups (Hovland and Wonderlic (*1*)). The present paper describes an abridgment of the Otis test, *standardized upon adults in business and industry,* which remedies the principal defects of the Otis Test and still retains its essential advantages. The abridgment, labelled the "Personnel Test," requires only twelve minutes, is self-administering, easy to score, reliable, and valid and useful in a number of industrial situations. The name "Personnel Test" was

* The Personnel Test may be obtained from the World Book Company, Yonkers-on-Hudson, New York, or from E. F. Wonderlic, 919 North Michigan Avenue, Chicago, Illinois. The test is not for general distribution; sale is restricted to technically qualified individuals for use in business, industrial and similar situations.

selected because it was found that this title lessens to a considerable extent the hesitancy and fear otherwise shown by many individuals when they are required to take an "intelligence" test. Furthermore, when an applicant does not meet a critical score required for employment, he is not made to feel as a result of the title that he is being turned down because of "lack of mental ability."

CONSTRUCTION AND FEATURES

Source of Questions. Over eight thousand Otis S–A tests, used in the former study (*1*) were available for determining the validity and difficulty of the individual items in the four forms of the Otis Test. On the basis of these data, three parallel forms of the Personnel Test were constructed, each containing fifty items from the Otis Test which had maximum validity and proper difficulty. Representative questions of each of the following types were included: analogies, analysis of geometric figures, arithmetic, direction following, disarranged sentences, judgment, logic, proverb matching, similarities, and word definitions. A number of experimental revisions were required before the final forms were completely satisfactory, since the difficulty of individual questions changes somewhat when the order of the items is altered. About five thousand cases were tested with the final forms for the purpose of obtaining norms. The three forms are designated "E," "F" and "G."

Difficulty of Items. The first defect of the original Otis Test which the present test corrects is that of level of difficulty. The original Otis, being standardized on children, was found to be too easy for a majority of adult industrial and business groups, even for those having means closely similar to the values reported by Otis (*3*). In the original Otis over a quarter of the questions were passed by between ninety and one hundred per cent of the individuals tested. Over sixty per cent of the items were passed by seventy-five or more per cent of the subjects. When items are passed by such a high

percentage of individuals they provide little basis for differentiation of ability (Symonds (*4*); Thurstone (*5*)). In constructing the Personnel Test care was taken to include questions representative of the entire range of difficulty, with an average such that about fifty per cent would pass and fifty per cent fail the item of mean difficulty. A few items passed by ninety or more per cent of the subjects were included as "warm-up" questions, and better to differentiate individuals of very high levels of ability several items were employed which were passed by less than ten per cent of the entire group of examinees. The distribution of difficulty for all fifty questions included in Form "D" of the Personnel Test is shown in Table 1. The results are based upon a group of

TABLE 1

Distribution of Difficulty of Questions in Personnel and Otis Tests
(Based on equivalent groups of applicants for positions administered by federal agency)

Per cent passing	Personnel test Form D No. questions	Otis test Form A, 30-minute No. questions
0– 9	/	
10–19	////	///
20–29	///	//
30–39	///// /	/////
40–49	///// //	///// /
50–59	///// ///	///// /
60–69	///// //	///// /////
70–79	///// /	///// ///
80–89	////	///// ///// ///// //
90–99	////	///// ///// ///// ////

applicants for positions administered by a federal agency. For comparison, the difficulties of the seventy-five items of the original Otis Test (Form A) for another group from the same population are also indicated.

Item Analysis of Validity. Determination of the validity of the individual questions provided another basis for selection

of items. To be included an item had to prove valid according to three successive criteria:

First. A question had to differentiate between successful and unsuccessful industrial employees. On the basis of extensive records on over eight hundred employees and ex-employees of Household Finance Corporation, two criterion groups were selected: Group I was made up of employees given high ratings by supervisors and having a record of two or more salary raises and at least one promotion. Group II contained employees with poor ratings and an unsatisfactory operating record, as well as a large number of ex-employees dismissed for inefficiency, especially for "failure to catch on" or "lack of understanding of the business." The items which were retained all showed significant differences in the percentages of correct responses for the two groups. The tests had all been taken prior to employment.

Second. Items were selected which differentiated between good and poor school records. Data were available on about 350 Northwestern University students. Items which were retained showed statistically significant differences between students in the upper and lower twenty-five per cent with respect to academic achievement. The groups were equivalent in age and year in college.

Third. The final criterion was total score on the test. Biserial coefficients of correlation were computed between total score on the test and the passing or failing of the individual items.

Percentage Finishing. The length of the test was made such that only about two to five per cent of average groups complete the test in the twelve-minute time limit. In the original Otis Test as many as forty per cent of some groups finished the test in the thirty-minute time limit. This, of course, results in undermeasurement of the brighter individuals in the group. In Table 2 a comparison is made of the percentages attempting various numbers of items in the Personnel Test and in the original Otis Test. The data are

TABLE 3

Distribution of Test Papers by Number of Questions Attempted on Personnel and Otis Tests
Applicants for Positions at H.F.C.

Personnel test (Form F)	
Number questions attempted	Percentage of test papers
19–22	/
23–26	////
27–30	///// ///
31–34	///// ///// ///// ///// /
35–38	///// ///// ///// ///// ///// //
39–42	///// ///// ///// ////
43–46	///// ///// //
47–50	///// ///

Otis test (Form A, 30-minute)	
Number questions attempted	Percentage of test papers
35–39	/
40–44	/
45–49	///
50–54	///// /
55–59	/////
60–64	///// /////
65–69	///// ///// /////
70–75	///// ///// ///// ///// ///// ///// ////

derived from two groups of applicants for jobs at H. F. C., the one given the Personnel Test, the other the Otis.

Order of Difficulty. The third difficulty with the original Otis Test is that the items are very inadequately arranged in order of difficulty. The correlations between the difficulty of the questions and the printed order were only from +.42 to +.75 for the groups which we studied. This permits indi-

viduals to get disproportionately high scores by skipping about and selecting the easy items. In the Personnel Test extreme care was taken to have the items uniformly increase in difficulty. It was found from the previous analysis of the Otis Test that a large number of items shift considerably in difficulty from group to group. Items of this sort which did not remain stable but were markedly easier for some occupational or educational groups than others were discarded in the present revision. Likewise, questions which were ambiguous or were skipped by large groups of people were omitted. The results of the restandardization are shown in correlations (ρ) of +.90 to .95 (P.E.'s = .009 – .015) between the order in which the items are printed in the Personnel Test and their difficulty in terms of the percentage of subjects passing them. These data are based upon all three forms, and upon diverse groups of subjects. When corrected for attenuation the correlations are all +.95 or higher.

Self-Administration. The popular self-administering feature of the Otis Test has been retained in the Personnel Test. On the first page of the test the subject reads for himself all the necessary directions. The fifty items constituting the examination are in a single series, and are answered without interruption. The examiner need only distribute the blanks, see that the directions are understood, and give the beginning and ending signals. Thus the administration can be carried out by any well-trained clerk. While primarily intended for group testing the Personnel Test can, of course, easily be given as an individual examination.

Scoring. The test can be scored very rapidly, in considerably less than a minute. The scoring is completely objective, with a single correct answer to each item. The scoring stencil has the answers in two parallel columns which are placed adjacent to the subject's answers.

Norms. Because of the specialized and restricted use of this test no attempt has been made to base the norms upon unselected populations representative of the country at large.

Instead, representative industrial and business groups were tested for the establishment of norms. Occupations included were: (a) outside representatives, (b) clerks and (c) managers of local offices of Household Finance Corporation, a personal loan organization; (d) vacuum cleaner salesmen; (e) typists; (f) Hollerith key punch operators, and (g) night school students representing various occupational classifications.

Conversion tables are also available for transmuting Personnel Test scores into Otis scores, but no tables corresponding to those of Otis (*3*) for determining *I.Q.* or *I.B.* are prepared, because it seems to us not only unnecessary but actually misleading to use such quotients for adults, particularly in industry and business; raw scores prove completely satisfactory. It must be emphasized, further, that the varying conditions from organization to organization, even for jobs given the same name, make it extremely desirable to obtain critical scores and norms for each new use, although the data obtained by us may prove to be useful in suggesting tentative norms for similar positions.

Distribution of Number of Items Correct. Sample distributions of the number of items correct for two widely diverse groups of examinees are given in Table 3. These populations represent vacuum cleaner salesmen and Northwestern University night school students, respectively. For a majority of the groups studied by us normal distribution curves are obtained.

Administration with Unlimited Time. While for most purposes the twelve-minute test provides a satisfactory measure of an individual's mental ability, in some situations it is desirable to use unlimited time to obtain a more adequate measure of an individual's mental "power." Consequently, norms have been obtained when the test is administered with unlimited time as well as in the customary twelve-minute period. The correlations between the scores in the twelve-minute period and with unlimited time are quite high (+.78 to +.94), in the case of individuals who are of approximately

TABLE 3

Distribution of Number of Items Correct on Form "D" of Personnel Test

No. items correct	Vacuum cleaner salesmen N = 100	N.U. night school students N = 121
3– 5	///	
6– 8	//	/
9–11	///// /	
12–14	///// //	
15–17	///// /////	/
18–20	///// ///// ////	/////
21–23	///// ///// ///// /////	///// ///// /
24–26	///// ///// ///// /	///// ///// /////
27–29	///// ////	///// ///// ///// ///// //
30–32	///// //	///// ///// ///// ///// /////
33–35	///	///// ///// ///// /////
36–38	//	///// ///// //
39–41	/	/////
42–44		//
45–47		/
		/

equal age (20–28 years). The correlations would presumably be lower with great heterogeneity of age because of the differential effect of age upon "speed" and "power" (Hovland and Wonderlic (*2*)). The average time required under conditions of unlimited time was about a half hour.

Comparability of Forms. The three forms of the test are closely equated in terms of average difficulty. This is indicated by the results of Table 4 showing the comparability of

TABLE 4

Comparability of Various Forms of Personnel Test

Group		Forms		
		"D"	"E"	"F"
I. College night school students	M	27.6	27.3	27.8
	σ	5.9	5.8	5.9
	N	141	138	146
II. Male employees of H.F.C.	M	29.3		29.6
	σ	6.3		6.3
	N	296		316
III. Applicants for jobs at H.F.C.	M	25.7		25.8
	σ	6.5		6.6
	N	490		512

mean scores of equated groups given one or another form in a randomized arrangement. In addition to being equated in average difficulty the forms are equivalent by successive fifths throughout the examination. Table 5 gives the average percentages of subjects passing questions in successive groups of ten. The percentages of subjects passing each individual question were first determined; from these the averages for successive groups of ten were computed. The table is based upon groups of college students, applicants for federal jobs and vacuum cleaner salesmen. The parallel remains even with considerable shift in difficulty. The comparability is further reflected in the practical equality of the standard deviations presented in Table 4.

TABLE 5

Average Difficulty of Questions in Successive Groups of Ten

Question group	Average per cent of examinees passing individual questions within group					
	Vacuum cleaner salesmen		Applicants for federal jobs		Northwestern University night school students	
	Form D N=220	Form F N=222	Form D N=138	Form F N=136	Form D N=121	Form F N=134
First 10 questions	82.5	83.2	85.7	87.3	94.3	93.1
Second 10 "	56.8	60.4	69.5	67.6	79.5	76.4
Third 10 "	43.0	44.5	51.6	52.2	67.2	68.3
Fourth 10 "	36.3	37.8	44.1	44.3	55.7	57.2
Fifth 10 "	12.2	14.7	27.2	30.9	34.4	38.4

RELIABILITY

The reliability of the Personnel Test was measured both by correlation between parallel forms and by the split-half technique. Results on the parallel form reliability are presented in Table 6. The order in which the forms were taken is indicated for all groups. The standard deviations of the two forms were averaged to indicate the range of ability. In the seventh column the reliability of the entire twenty-four minute examination is predicted from the intercorrelation between the forms (Spearman-Brown prophecy formula). In the last columns the reliability of the original Otis Test is given for a number of groups. Forms A and C of the Otis tests (thirty-minute time limit) were given to groups selected from the same populations as those given the Personnel Test.

Comparison of the reliability coefficients of the two tests indicates that the Personnel Test gives about as reliable an indication of the individual's ability in twelve minutes as does the Otis Test in a thirty-minute period. Administration of *two* forms of the Personnel Test requires less time than *one* of the original Otis, and in twenty-four minutes of testing time

TABLE 6

Reliability: Correlations between Parallel Forms of Personnel Test (and Comparison with Otis Test)

Forms compared	Personnel test					Otis test Forms A and C			
	Groups	N	r	Avg. S.D.	P.E.$_{1\infty}$	Predicted r for both tests	N	r	Avg. S.D.	P.E.$_{1\infty}$
D and E	Appl. for jobs at H.F.C. (D first)	137	.88	6.98	1.63	.94				
D and E	Northwestern U. students (E first)	62	.85	5.94	1.56	.92	103	.78	8.3	2.59
D and F	Evanston Township H.S. sts. (D first)	143	.83	5.64	1.57	.91	95	.81	8.5	2.48
D and F	H.F.C. male employees (D first)	296	.85	6.36	1.67	.92				
D and F	H.F.C. male employees (F first)	316	.85	6.34	1.66	.92				
D and F	H.F.C. female employees (D first)	200	.84	6.06	1.63	.91				
D and F	H.F.C. female employees (F first)	216	.85	5.89	1.54	.92				
E and F	Appl. for Fed. WPA educ. jobs (E first)	136	.89	6.38	1.44	.94				
E and F	Vacuum cleaner salesmen (F first)	209	.92	7.83	1.50	.96				

a more reliable estimate of mental ability is obtained than with the thirty-minute Otis Test. It must constantly be borne in mind that the groups employed by us in determining reliability were considerably more homogeneous than the relatively unselected populations used by Otis in computing his reliability. When groups selected on the same basis as the ones which we employed for determining the reliability of the Personnel Test are given the Otis Test, the reliabilities are seen to be closely similar. The reliabilities obtained are, incidentally, almost exactly what would be predicted from the probable error of scores reported by Otis (*3*). The standard deviations for Otis' subjects were presumably from 13.3 to 14.4, judging from the reliability and probable errors of scores which he reports. The standard deviations on the Otis test for our groups were from 6.6 to 11.7.

From the table it will be seen that the probable errors of obtained scores on a single form of the Personnel Test are between 1.44 and 1.67. Those reported by Otis for the Higher Examination were 2.56 and 2.68.

The split-half reliabilities and the probable errors of scores computed from them are given in Table 7. The predicted reliabilities for administration of both forms are also reported. In the last columns are given the split-half reliabilities obtained with the Otis Test on groups closely comparable to the ones used for the Personnel Test. The split-half reliabilities are, as might be predicted, slightly higher than those with parallel forms, presumably because of the absence of factors similar to quotidien variability which affect the latter. The considerations with respect to the homogeneity of our groups mentioned in the above paragraph likewise apply here.

The fact that the reliability of the Personnel Test is about as high with twelve-minute administration time as is the Otis with thirty, is presumably due to the method of restandardization. It will be recalled that the Personnel Test has items uniformly distributed throughout the entire range of difficulty, whereas too many of the Otis Test items are concentrated at

TABLE 7

Split-Half Reliability of Personnel Test (and Comparison with Otis Test)

Form	Personnel						Otis				
	Group	N	r	S.D.	P.E.$_{1\infty}$	Predicted r for both tests	Form	N	r	S.D.	P.E.$_{1\infty}$
D	Applicants at H.F.C.	312	.90	6.48	1.38	.95	A	100	.86	9.7	2.44
D	Northwestern U. students	100	.88	5.65	1.32	.94					
D	H.F.C. male employees	362	.88	6.28	1.48	.94					
D	Vacuum cleaner salesmen	220	.94	8.02	1.33	.97					
E	Evanston Township H.S. sts.	175	.85	5.45	1.39	.92	A	95	.80	8.4	2.51
F	H.F.C. male employees	372	.90	6.33	1.36	.95					
F	Applicants at H.F.C.	201	.89	6.44	1.43	.94					
F	Appl. for Fed. WPA educ. jobs	136	.89	6.35	1.44	.94	C	136	.90	11.7	2.39

the easy end of the scale. In addition, only the most valid items from the Otis Test are employed and these are arranged in a stable progressive order of difficulty. It must be emphasized, however, that the weaknesses of the Otis Test might only be present in adult testing and that the instrument is probably highly satisfactory for use with children. Furthermore, it is possible that with completely naïve examinees, never previously tested, sources of unreliability might appear with the Personnel Test which were not obtained with our groups. It might be, for example, that misunderstanding of directions and consequent slow starting might be disproportionately important with a test as short as twelve minutes.

Retesting of Borderline Cases. By using a test as short as the Personnel Test and retesting only those cases in the borderline region near the critical score, it is possible to shorten testing time for the majority of cases and at the same time attain reliabilities ordinarily obtained only with longer tests, for the individuals in whose cases maximum discrimination is desirable. Cases clearly above the critical score or clearly below the critical score need not be retested since the unreliability of the tests would not change their scores sufficiently to alter their treatment, but individuals near the critical score may profitably be retested to reduce the margin of error. In our organization, for example, we have set the critical score at 25 for employing men for the position of junior managers. Men getting 28 or above (two probable errors above the critical score) qualify without retesting. Similarly, those getting 22 or below are dropped from further consideration immediately. Applicants obtaining scores between 23 and 27, however, are retested when they qualify in all other respects. If on the second form they attain a score sufficiently high to give them a total score on both forms of 52 or above, they qualify. The latter score is more than twice the critical score of 25, because of the practice effect which averages a little less than two questions. Thus by double testing of only the doubtful cases, the practical effect of a lengthened test reliability is obtained with a minimum expenditure of time.

To permit even more precise discrimination between individuals in the borderline region between 22 and 28 we have developed a new test (Form K). The items in this form vary within a narrow range of difficulty with an average difficulty such that just fifty per cent of a group of individuals with scores of 25 on Form D will pass the median question on Form K. This form serves to give a satisfactory dispersion of scores in this range where otherwise they are closely concentrated.

VALIDITY

As in the case of any other mental test, the validity of the Personnel Test cannot be ascertained directly. A number of indirect methods, however, indicate highly satisfactory validity. The indicated bases for determination of validity are: (1) the method of construction, (2) correlation with other tests, and (3) prediction of industrial success.

Construction. The Personnel Test was prepared by using items from the Otis Test, which, despite, weakness, has been shown over a long period of time to be highly valid for the measurement of mental ability. Furthermore, only the items having the highest individual validity were employed. The use of three successive criteria for the individual items helps to insure further the validity of the entire scale.

That the short-time interval for administration of the test does not make the test just a matter of speed is indicated by the high correlation obtained between limited and unlimited testing time (see above). The values are of the same magnitude as those reported with other well-standardized mental ability tests.

Correlation with other Tests. The second line of evidence is the correlation between the Personnel Test and the Otis Test from which it was derived. The correlations between the Personnel Test and the original Otis Test are from + .81 to .87 (P.E.'s = .01 – .02) for a number of different groups. The interval between the two tests was from two weeks to one month. On the average there are about twelve items which are common

to single forms of the Personnel and Otis Tests. This makes the correlations higher than they would be if entirely independent tests were employed. For the purpose of establishing the validity of a restandardization of the same test, however, no serious error is introduced. The correlation between the Personnel Test and the Otis does not show a perfectly linear regression, since, as would be predicted, there is greater scatter on the high scores of the Personnel Test than on the Otis due presumably to the inadequate difficulty of the Otis Test and the excessive time limit.

Another correlation indicative of validity is one of +.79 between the Personnel Test and the American Council Test on a group of two hundred Northwestern University students. This is quite high when one considers the restricted range of talent in such a group.

Prediction of Industrial Success. The third indirect method of testing validity is particularly important for a test to be used in business and industry. Too often tests are employed which have been validated and standardized in academic situations without specific determination of their usefulness in the actual situation in which they are to be used. The validity of the Personnel Test has been established in a number of industrial situations; three recent studies concerning its use will be cited. The first study was carried out at Household Finance Corporation where the test has been used for selecting outside representatives. It was desired that men be selected who would not only prove satisfactory in their immediate work but would also be likely prospects for future managerial positions. It was found after setting the critical score at 25, that seventy-eight per cent of individuals who were selected as "experiments" because they scored below that point resigned or were dismissed before the end of a year, whereas only eighteen per cent who scored above that point resigned or were dismissed in the same period. Selecting the critical score at 25 retained eighty-six per cent of the individuals who stay a year or over and only thirty-five per cent of those who resign or are dismissed within a year.

In a follow-up study supervisors were asked to pick one hundred men whom they considered to have been outstanding successes over a period of four years. The scores of these men were then compared with those of a group of one hundred men who had failed to progress and would probably ultimately resign or be dismissed. The successful employees averaged 29.7 ($\sigma_M = .55$) and the unsuccessful 25.0 ($\sigma_M = .58$). The difference in mean score (C.R. = 5.9) is particularly significant in view of the fact that these employees had been previously selected on the basis of the original Otis Test and hence represented a selected group. An even more pronounced difference was found between managers rated as outstanding successes or failures. The mean for the former was 32.0 and for the latter 25.7.

Another study which has been reported to us was carried out at the Pennsylvania Company, a large insurance and annuity organization. There it was found that the Personnel Test was of value in the selection of machine bookkeepers. This job involves posting entries on bank statements and deposit ledgers, work not requiring a very high level of mental ability. It was found that when a score of 14 on the Personnel Test was selected as a critical score, only one-seventh of the satisfactory bookkeepers scored lower than that, whereas more than half of the poorer bookkeepers were below that point.

The last and most recent investigation of validity has been in connection with the H. F. C. training school. New employees are given a two-week course in public contact work and interviewing. Part of the work is done in class and part under individual supervision. During the period the trainers have a good opportunity to observe the work of the students, and they keep systematic records of their evaluations of the mental ability of each student as displayed during the course. When one hundred students had been trained the instructors were asked to place them in rank order of apparent mental ability. No information was ever given to the instructors concerning

the test scores. The correlation (ρ) between the average rank assigned by the two instructors and the rank on the Personnel Test was $.59 \pm .05$. This is especially significant in view of the narrow range within which the Personnel Test scores of the students fall.

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THE RELATION OF PERSONALITY TRENDS TO DEGREES OF VISUAL CONSTANCY CORRECTION FOR SIZE AND FORM

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THE inherent subjectivity of questionnaire tests of personality leads eventually to attempts to establish the existence of traits by means of objective laboratory methods. Without commenting on the validity of the results, we may illustrate the latter method by recalling a few familiar instances. Kretschmer's attempt to trace temperament to body-build; the relationships established by J. W. Pinard and R. B. Cattell between character traits and laboratory tests of perseveration tendency; Gatewood, Guilford, and Hunt's studies showing large day-to-day variations in mental output in schizoid personalities—all of these represent attempts to establish a psychology of traits on more secure foundations than are afforded by "paper" tests, as we may call them.

In the class of such objective studies, there is one that has particularly attracted our attention. Robert H. Thouless,[1] whose studies of the phenomena of visual constancy are suggestive, reports the following observation: During the course of an extended study of brightness, shape, and size constancy, Thouless noted that extroverted or cycloid subjects tend to show larger amounts of visual constancy than do introverted or schizothymic subjects. That is, the schizothymic subject tends, as we would expect, to see external objects in terms of their stimulus character rather than in terms of their "real" character. The paper in shadow, the distant object, the inclined circle impress him as having the stimulus properties of the moment. The introvert should find it quite natural to

[1] Thouless, R. H., Individual differences in phenomenal regression, *Brit. J. Psychol.*, 1931–32, 22, 216–241.

treat an external object as a sensation, as a phenomenon rather than as a real object. The object-directed extrovert, on the other hand, because of an equally natural preference for practical articulations with external objects, will tend to see such objects in their real characters. In order to verify this casual observation, Thouless selected two groups of subjects of 14 members each, one group conforming as closely as possible to Kretschmer's description of the cyclothymic temperament, the other group to the schizoid temperament. The records of these subjects on the constancy tests show that the cyclothymic subjects show larger average indexes of constancy correction (or of "phenomenal regression," as Thouless prefers to call it) for brightness, form, and size.

During the winter of 1937 we made an attempt to check the observation made by Thouless. Seventy-six sophomores, all of them women, served as subjects. Each of them took J. P. Guilford's new test,[2] based on the new method of factor analysis, and intended to measure three somewhat related attributes of personality: social introversion, emotionality, and masculinity. Since Guilford considers that masculinity as measured by this test is somewhat unsatisfactory as a definitive factor, we scored this test for social introversion and emotionality only. The author also made a personal attempt to rate the subjects on a seven-fold scale on intro-extroversion, based on his personal acquaintance with them. Each subject also took the Allport A. S. Reaction Study.

The visual constancy tendencies of the subjects were determined by means of stereograms constructed by the author as a convenient and "in-door" method of measuring degrees of size and form correction. The set of size constancy stereograms consists of 16 slides made up of paired photos of a round white disc photographed on an open lawn at four different distances (3, 6, 9, 12 meters), involving four degrees of disparition for each distance. The form constancy set consists of 15 similar slides made up of paired photographs of a table top tilted at

[2] Guilford, J. P., and R. B., Personality factors S, E, and M, and their measurement, *J. of Psychol.*, 1936, 2, 109–127.

five degrees of inclination from the vertical position (30, 40, 50, 60, 70 degrees) in the various slides. For each degree of inclination, again, there were slides representing three different degrees of disparition.

Each subject made but three observations for each slide, in each case gauging the size or form of the stereoscopic object, and then selecting an equivalent object from charts of comparison areas (where size judgments were made), and from charts of comparison ellipses (where form judgments were required). For both the size and form series, control determinations were made by having the subjects gauge the sizes and forms of special slides made by cutting out the size discs and the table tops and mounting them on gray cardboards suitable for insertion in the stereoscope. Since the cues utilized in the constancy correction processes come from the field surrounding the object, the control slides seem suited for gauging the subject's natural tendencies to over or underestimate size and form when uninfluenced by the constancy tendencies. In this way it is possible to measure quantitatively the subject's tendency to make size and form corrections for the test objects in the photographed field, corrected by the measurements of mere tendencies to make errors of judgment of size and form as shown by the control slides.

Three observations on each slide may seem insufficient for measuring an individual's constancy tendencies. Actually, of course, since the sets of slides numbered 15 and 16, we have 45 and 48 observations from each subject. Moreover, repeated trials seem unnecessary because the deviations of an individual's judgments for a given slide are small. For instance, the correlation between the first and second choices of comparison areas for size slides, taking 200 judgments as materials for the correlation, is $+.954$ ($\pm .005$). For the form slides, first and second choices for identical slides show a correlation of $+.984$ ($\pm .001$). Other correlations of this sort indicate that individual determinations vary very little during a given laboratory sitting. We are unable to state how constant such judgments

are from day to day: Thouless reports that the day-to-day constancy of such judgments is high.

We used the critical ratio method as a means of determining the relations of visual constancy to personality traits. Since there were 76 subjects, we formed groups of the 25 most introvert and the 25 most extrovert, and then compared these opposed groups as regards visual constancy. The same procedure was followed in determining the differences in visual constancy in other personality trait groups. The results are given in Table I.

TABLE I

Personality Traits and Visual Constancy

	Trait groups	N	Type C.C.	Av. C.C.	D	D/S.E.d	Probability
1.	Extrovert-test	25	size	76.0			
	Introvert-test	25	size	37.0	39.0	1.851	96.5
2.	Extrovert-rating	25	size	79.7			
	Introvert-rating	25	size	29.0	50.7	2.136	98.4
3.	Extrovert-test	25	form	19.3			
	Introvert-test	25	form	15.9	3.4	1.094	86.0
4.	Extrovert-test	25	size + form	46.6			
	Introvert-test	25	size + form	27.4	19.0	1.713	96.0
5.	Low emotionality	25	size	57.0			
	High emotionality	25	size	52.2	4.8	.276	61.0
6.	Low emotionality	25	form	17.4			
	High emotionality	25	form	16.6	.8	.244	59.0
7.	Ascendancy	24	size	62.5			
	Submission	24	size	59.3	3.2	.141	55.0
8.	Ascendancy	24	form	19.7			
	Submission	24	form	17.5	2.2	.586	72.0
9.	Ascendancy	24	size + form	42.0			
	Submission	24	size + form	38.3	3.7	1.532	93.0

The amount of average constancy correction for each group, whether for size, for form, or for both, is given under the caption "C.C. Score" in the table. These values are percentages of the average excess of size (or of shape) of the experimental as compared with the control determinations. It will

be seen that these corrections are large, especially for the size determinations. Thus, in the first line, the 25 most extroverted subjects tend to see the photographed discs as 76 per cent larger than the very same discs when cut out and mounted on the control slides.

GENERAL RESULTS

Intro-extroversion appears to be the most definitely associated with visual constancy in this study. The last column to the right gives the probability that the differences found between groups are "true differences" on the basis of 100. For size constancy, the ratios and probabilities are the best in the table, and suggest that extroverts make reliably larger size corrections than do introverts. Judgments of form, however, give disappointing results. Perhaps to the introvert, traditionally supposed to be a good bookworm, the table-top is an especially "real" object! In comparisons No. 4 and 9, size and form are averaged.

Guilford considers that subjects who earn high emotionality scores on his test are at once more emotional on the whole, and exhibit a tendency to emotional dependency on others. The differences between high and low emotionality groups are lowest of all. Psychologically, there is perhaps no reason for expecting that emotional traits should affect constancy corrections. Guilford's results as well as our own show that low emotionality correlates positively with extroversion, in our study to the extent of $+.366$ ($\pm .066$). Hence, the slightly superior constancy correction of subjects with low emotionality is perhaps due to the positive association of low emotionality with extroversion. The differences between groups of ascendant and submissive subjects are of intermediate value. There is a tendency for ascendant subjects to show larger constancy corrections. Again, this may be due to the association of ascendancy with extroversion, which in the case of Guilford's test is $+.697$ ($\pm .039$).

None of the critical ratios on our table indicate absolute reli-

ability. However, in the case of intro-extroversion, they are high enough to be significant. This study gives experimental support to the belief that the distinction between introversion and extroversion is somehow valid. It suggests also that introversion and extroversion are true personality traits in the sense that a true personality trait is not confined to one manifestation, but implies a stable organization of sub-traits. That extroverts should make larger constancy corrections is a natural inference from the prevalent conception of extroversion as a tendency to accept an object-directed attitude.

ADAPTING TESTS TO MACHINE SCORING

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ONE of the important problems confronting the increasing number of users of the new IBM Test Scoring Machine is the adaptation of examination material to the limitations of the device. It is the purpose of this article to give examples of the manner in which several kinds of orthodox test material and certain hitherto unused tests have been constructed and arranged to conform to the limitations and advantages of the IBM machine. No effort will be made to go into the use of such types of material as have already been adequately covered in literature available from the manufacturer, nor to discuss the merits or demerits of the machine method and its possible effect on the reliability and validity of the testing process.

The examinations with which this article is concerned were constructed for the Employment Board for the Department of Public Assistance in Pennsylvania. The immediate task confronting the Board was the selection under a merit system, and in the shortest possible time, the Assistance Department's entire personnel of 7,500 for jobs ranging from executive director to janitor. The large number of positions to be filled and the fact that the law expressly forbade the elimination of any applicant on the basis of his education or experience, resulted in a larger number of candidates requesting to take the examinations than had ever before been encountered in either of the other two civil service set-ups in the State. This situation, combined with the fact that little remained of a time dead line

* The following individuals contributed many valuable suggestions: Mr. Herman A. Copeland, Dr. Joseph W. Hawthorne, Mr. Jack H. Pockrass, and Dr. E. A. Rundquist. The adaptation of the proof-reading and paragraph-meaning tests was largely the work of Dr. George K. Bennett, Dr. Kenneth S. Wagoner, and Mrs. Anne K. Zink.

imposed by the legislation creating the Board, impelled those charged with setting up, administering, and scoring the examinations to turn to completely objective tests and to seek the aid of the new electric scoring machine. Two other limitations imposed on the examiners, that "the examinations shall be practical in character" and that their length tend to reflect the importance and rate of pay of the various positions, were other factors which influenced the selection of certain of the types of material to be illustrated.

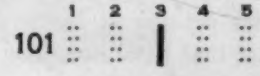
While it may seem to some that the directions given examinees in the following examples are frequently too lengthy, it should be remembered that most of the applicants for whom the tests were designed had never before taken an objective test of this type and many had not been in a schoolroom for a number of years. In addition, the introduction of a separate answer sheet with the attendant necessity for mastering further instructions or being penalized in score might, unless guarded against, have resulted in testing for skills other than those the examiners had in mind. This was especially true for the lower level positions.

AN ALPHABETIZING TEST

Directions:

Rearrange the names in each of the following groups in the order in which they would appear in an alphabetic file. List the number in parentheses after each name in the blank at the right so as to show the alphabetic order of the names. Then, *on the ANSWER SHEET*, indicate the alphabetized order by making a heavy mark in the appropriately numbered space opposite the proper question number.

For example, when you alphabetize the names in the first group below, you will find that the name followed by the number 3 in parentheses belongs after No. 101. You will therefore make a heavy mark in space number 3 after question No. 101 on your *ANSWER SHEET*, thus:



Mary Ciarmatore (1)	101.	*Anthony Cianciarulo (3)*
Leo Ciatto (2)	102.	
Anthony Cianciarulo (3)	103.	
Ora Ciarrocchi (4)	104.	
Alfonso Ciango (5)	105.	

Lysle Produce Corp. (1)	111. _____
Lyxer Laboratories, Ltd. (2)	112. _____
The Lyver Memorial (3)	113. _____
Lyons Water Co. (4)	114. _____
Lytell and Barton, Inc. (5)	115. _____

A SORTING TEST

Directions:

This is a sorting test. If each name with its corresponding city represents an addressed letter, how many letters are addressed to each city listed?

Use the blanks following each city for purposes of counting. If the name of the city to which the letter is addressed is not listed, count it as "Miscellaneous" (No. 105). When you have finished sorting the letters, count the number addressed to each city and indicate the total for each city by making a heavy mark in the proper space on the ANSWER SHEET.

For example, if it is found that *three* letters are addressed to No. 90, Lock Haven, make a heavy mark in space number 3 beside the *number* of that city on the ANSWER SHEET, thus:

NAME	CITY	NAME	CITY
Moore	Reading	Gray	Lancaster
Evans	Scranton	Cooper	Harrisburg
Foster	Philadelphia	Force	Johnstown
Brown	Johnstown	Burtt	Pittsburgh
Jones	Pittsburgh	Lewis	Reading
Carter	Carbondale	Hanks	Lancaster
Martin	Pittston	Rogers	Philadelphia
Dewey	Lewistown	Paoli	Altoona
Green	Harrisburg	Beck	Lewisburg
Hope	Williamsport	Hyde	Allentown
Taylor	Lancaster	Vaughn	Pittsburgh
Scott	Allentown	Cort	Scranton
Duffy	Reading	Bailey	Waynesburg
Hall	Pittsburgh	Arno	Carbondale
Crown	Wilkes-Barre	Murphy	York
Wells	Philadelphia	Kahn	Wilkes-Barre
Fink	Lewistown	Rolfe	Pittston
Sporn	Pittston	Borg	Lewistown
Call	York	Hansen	Harrisburg
Swift	Scranton	Rees	Reading
Harris	Philadelphia	Roth	Chester
Moses	Erie	Prince	Philadelphia
Brand	Harrisburg	Creel	Scranton
Moon	Carbondale	Yule	Pittsburgh

91. Allentown _____
92. Carbondale _____
93. Erie _____
94. Harrisburg _____
95. Johnstown _____
96. Lancaster _____
97. Lewistown _____
98. Philadelphia _____
99. Pittsburgh _____
100. Pittston _____
101. Reading _____
102. Scranton _____
103. Wilkes-Barre _____
104. York _____
105. Miscellaneous _____

A SYLLABIFICATION TEST

Directions:

Assume that it is necessary to divide each of the following words at the end of a typewritten line.

One word in each group is *incorrectly divided*. Indicate the *number* of that word by making a heavy mark in the proper space on your ANSWER SHEET.

166.	(1) sta-tion; (2) incon-venience; (3) occ-asion.	166
168.	(1) pro-gram; (2) se-dative; (3) prod-uct.	168
171.	(1) rem-ittance; (2) main-tain; (3) reple-tion.	171
175.	(1) cri-tic; (2) brak-ing; (3) produc-tive.	175
179.	(1) presump-tuous; (2) prep-aration; (3) spea-ker.	179
180.	(1) his-sing; (2) perspira-tion; (3) mainte-nance.	180

A PUNCTUATION TEST

Directions:

Note the *punctuation* in each of the following sentences and make a heavy mark in the appropriately numbered space on your ANSWER SHEET to indicate whether the sentence is correctly *punctuated* or not, thus:

1. Correctly punctuated
2. Incorrectly punctuated

21.	The clerk was ill	21
22.	He received a telephone call from Paris.	22
39.	"The material," he replied, "was received this morning."	39
45.	Mr. Spector who is a minister arrived on a late train.	45
46.	A roof, that leaks, ought to be repaired immediately.	46
48.	The train started; the crowd shouted; the band played.	48

A SPELLING TEST

Directions:

One word in each of the following groups is spelled incorrectly. Make a heavy mark in the proper space on your ANSWER SHEET to indicate the *number* of the *misspelled* word.

121.	(1) economize; (2) cornor; (3) almanac.	121
129.	(1) accede; (2) ninteenth; (3) memorandum.	129
133.	(1) contemptible; (2) optimistic; (3) benefitted.	133
139.	(1) suppress; (2) superintendant; (3) vigilance.	139
161.	(1) pernicious; (2) acknowledgment; (3) finaly.	161
165.	(1) subtrafuge; (2) sufficiently; (3) weird.	165
168.	(1) bachlor; (2) audience; (3) cafeteria.	168
170.	(1) conscious; (2) brilliant; (3) boundery.	170
171.	(1) glanduler; (2) glimpse; (3) religion.	171

A CODING TEST

Directions:

Coded indexes of *counties by districts, city population groups, sex and veteran status,* and *occupations* appear on the following pages. Refer to these indexes to code the information given in each of the problems which follow the code tables.

Each code number to be constructed will be composed of six digits arranged in the following order:

the *1st and 2nd digits* (from left to right) represent the geographical district in which the county is located

the *3rd digit* represents the population group into which the *city* falls

the *4th digit* represents the applicant's sex and veteran status

the *5th and 6th digits* represent the applicant's occupation

For example, in the code number *159394*, the *15* represents the *district*, the *9* represents the *city population group*, the *3* represents the *sex and veteran status*, and the *94* represents the *occupation*.

SAMPLE PROBLEM TO BE CODED:

The code number of an applicant from Crawford County, living in a city of 10,000 population, a male veteran with no dependents, whose occupation is listed as bookbinder is: (1) 051216; (2) 152195; (3) 019353; (4) 103421; (5) 084532. *019353*

Referring to the following tables, it will be seen that the code corresponding to the district in which Crawford County is located is *01*, the code corresponding to the population group which includes a city of 10,000 is *9*, the code corresponding to a male veteran with no dependents is *3*, and the code corresponding to the occupation of bookbinder is *53*. Combining these so that they are arranged from left to right in the order shown above, the code number for the applicant is 019353. Since this is the third choice in the problem above, a heavy mark would be made on your ANSWER SHEET in space number 3, thus:

Be sure to arrange the digits in the same order as that shown above. It will be helpful, during the process of constructing the code number, to write it in the margin of the page, as has been done in the example above. This is only to aid you in comparing the number with the five choices

given in the problem. To receive credit for your answer, you *must* make a heavy mark in the proper space on your ANSWER SHEET.

Now turn to the problems following the code indexes.

Four tables entitled *Code of Counties According to Geographical Districts, Population Code for Cities, Code for Indicating Sex and Veteran Status,* and *Code of Occupations* appeared on the succeeding two and one half pages and were followed by this final summarizing direction useful for reference purposes:

> In constructing the code number, arrange digits in the following order (from left to right):
>
> *1st and 2nd digits:* geographical district in which county is located
>
> *3rd digit:* population group into which the city falls
>
> *4th digit:* applicant's sex and veteran status
>
> *5th and 6th digits:* applicant's occupation
>
> 31. The code number of a male applicant from Erie County, living in a city of 2,000 population, a non-veteran, whose occupation is listed as barber is: (1) 011116; (2) 019132; (3) 019141; (4) 109241, (5) 019123. 31
>
> 35. The code number of an applicant without dependents from Venango County, living in a city of 15,150 population, who was employed as a waitress, is: (1) 028518; (2) 028415; (2) 028418; (4) 028515; (5) 027518. 35
>
> 37. The code number of a male non-veteran applicant with two dependents, living in a city of 30,002 population, in Lycoming County, whose occupation is chair framer is: (1) 047237; (2) 057234; (3) 047137; (4) 037134; (5) 057234. 37
>
> 41. The code number of a non-veteran male applicant with one child, who was employed as a janitor in his city of 29,539 population in Allegheny County is: (1) 098100; (2) 098200; (3) 087100; (4) 097200; (5) 087200. 41
>
> 51. The code number of a female applicant with no dependents, living in a city of 15,030 population, in Fayette County, whose occupation is cloth finisher in a woolen mill, is: (1) 109438; (2) 109538; (3) 108547; (4) 108447; (5) 107339. 51

Several methods of adapting clerical checking tests to the use of answer sheets were devised. The two found most suitable are reproduced here. Neither approach exactly duplicates the standardized Minnesota version but, while it was recog-

nized that certain "foreign elements" entered the situation, the resulting arrangements appeared to be sufficiently satisfactory to warrant inclusion in the battery pending experimental evidence casting additional light on the problem.*

It will be noted that both forms shown make use of *separate* answer sheets. If it is desired to approach the standardized situation more closely, however, the numbers and names may be printed directly on answer sheets and the space between each pair provided with one or two sets of dotted lines for indicating responses. Such an arrangement would probably provide norms very similar to those secured with the standardized form but would be extremely uneconomical from the standpoint of making maximum use of the answer sheet. Still another alternative would be to print the test so as to provide easy articulation with the standard two-choice answer sheets now available.

CHECKING TEST I

Directions:

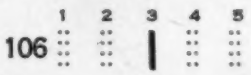
In each of the following groups, some of the pairs of names and numbers are *exactly the same* while others are *different.*

You are to check, on the connecting line, the pairs which are *different* and indicate on your ANSWER SHEET the *total number* of such pairs in each group.

EXAMPLE:

106.	Fountain Mfg. Works		Fountain Mfg. Works
	Perry Joy	V	Perry Jay
	Sund Machine Co.		Sund Machine Co.
	Standard Frame	V	Standart Frame
	Deauville Shores	V	Deauville Shore

In the example above, three pairs are *different* so you are to make a heavy mark in space number 3 opposite question No. 106 on your ANSWER SHEET, thus:



Be sure you have marked No. 106 on your ANSWER SHEET, then go on to No. 107. Work as fast as you can without making mistakes.

* Such data are at present in process of compilation and are expected to be the subject of a forthcoming article.

107.	Auto Service Shop	Auto Service Shop
	Alester & McAlester	Alester & McAlester
	Van & Van De Vyere	Van & Van de Vyere
	Raymond Pretschold	Raymond Pretschold
	Kassanitsch Storage	Kassanitsch Storage
111.	Thomassen Polonia	Thomssen Pollonia
	George Wienhoeber	Geo. Weinhoeber
	Leo Pfaelzer & Son	Leo Pfaelzer & Son
	Smithsen Paulding	Smithson Paulding
	Samuel R. Lurya	Samuel R. Lurya
145.	529	529
	3270	3290
	4378	4398
	698	698
	532149	532149
147.	17287	17287
	27355453231	27355453731
	829	829
	53728	53728
	3212	3212

CHECKING TEST II

Directions:

The inside pages of this booklet contain three tests which will be timed. The first test consists of pairs of numbers and the second test of pairs of names. If the numbers or the names of a pair are *exactly the same*, make a heavy mark in space number 1 on your ANSWER SHEET beside the corresponding number of that pair. If they are *different*, make a heavy mark in space number 2 on your ANSWER SHEET.

The third test consists of simple arithmetic calculations. If a problem is *correct*, make a heavy mark in space number 1 on your ANSWER SHEET beside the corresponding number of that problem. If it is *not correct*, make a heavy mark in space number 2.

SAMPLES DONE CORRECTLY

Question Booklet		*Answer Sheet*
1. 453	435	1 (1 ●, 2
2. 6125	6125	2 (1 |, 2 ●)

3. William Johnson ..... William Johnson

4. Abraham and Link Co. ..... Abraham and Lind Co.

5. 4+8=12

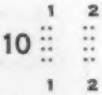
6. 3×6=15

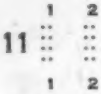
NOW DO THE SAMPLES BELOW

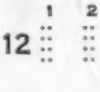
7. 326 326

8. 7418 7814

9. Samuel Dillon ..... Samual Dillon

10. Markwell and Gordon ..... Markwell and Gordon 

11. 14×5=70 

12. 12÷6=3 

A PARAGRAPH-MEANING TEST

Directions:

Each paragraph below includes *one* word which spoils the meaning of the paragraph. This incorrect word is one of the five having numbers printed immediately above them. When you have found the incorrect word, make a heavy mark on your ANSWER SHEET in the space having the same number as the incorrect word.

125. The tragedy of (1) man is that he has developed an (2) intelligence eager to uncover mysteries, but not dull enough to (3) penetrate them. (4) (5) 125

129. But we may disagree with all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. 129

130. A single ruling force need not be indefinitely imposed upon even worshipful subjects if they feel that their interests are being upheld or themselves imposed upon. 130

132. It is even more certain that nature is the expression of a definite order with which everything interferes, and that the chief business of mankind is to learn that order and govern themselves accordingly. 132

135. The application to industry of scientific discoveries and inventions, with the consequent great development of machinery and every form of capital, has wrought a tremendous decrease in the production of nearly every commodity desired by man. 135

144. Probably the first meeting ground of people was on the battlefield. Collisions of interest in the struggle for existence occurred and men knew no better way of settling them than by peaceful encounter. 144

A PROOF-READING TEST

Directions:

The two paragraphs under *Copy A*, below, consist of twenty lines which are absolutely correct. *Copy B* has been typed from Copy A and contains various kinds of errors.

Compare Copy B *line for line* with Copy A. Determine the number of errors in each line and indicate that number by making a heavy mark in the appropriate space on your ANSWER SHEET.

Each line is *numbered* as a *separate question*. Lines that contain no errors should be marked as choice number 5. Lines that contain one error

are to be marked as choice number 1—two errors, choice number 2—three errors, choice number 3—four errors, choice number 4.

COPY A

ALL THE STATE LAWS are administered separately by the States, but under the Social Security Act the Federal Government grants money to the States to pay costs of administering State unemployment compensation laws which are approved by the Social Security Board.
UNEMPLOYMENT COMPENSATION is undertaken by the State to protect working people against the risk of losing their jobs. But the whole community suffers when workers are unemployed, and the weekly payments to those

COPY B

251.	ALL THE STATE LAWS are administered separatley by	251
252.	the States but under the Social security Act t he Federal	252
253.	Government grants money to the States to pay cost of ad-	253
254.	ministiring State un-employment compensaton laws which	254
255.	are approved bythe Social Security Board,	255
256.	UNEMPLOYMENT COMPENSATION is under taken by	256
257.	teh State to protect working people against the risk os los-	257
258.	ing their jobs But the whole community suffer when	258
259.	workers are unemployed, and the weekly payments ot those	259

CENTILE AND T-SCALE NORMS FOR REVISED ALPHA EXAMINATION, FORM 5

GILBERT S. MACVAUGH[1]

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THE aim of this paper is to present a centile and a T-scale designed to supplant the incomplete centile scale now published for the *Revised Alpha Examination*, form 5 (F. L. Wells 1932). Wells' norms are incomplete because one cannot assign a centile rank to a subject making a score of 60 or less.

The subjects who took the above test for the present study were a random sample of 5000 adult, male, English speaking, literate prisoners tested in the psychological clinic at the United States Penitentiary, Leavenworth, Kansas, between February 1933 and October 1936 inclusive. The average chronological age was 34.9 ± 0.0 years; $\sigma = 10.1 \pm 0.0$; $Q_1 = 27.5$; $Me = 33.0$; $Q_3 = 40.6$; range 18 to 76. On the *New Stanford Achievement Test*, form W, the group showed a mean educational age of 13.4 ± 0.1 years; $\sigma = 2.3 \pm 0.0$; $Q_1 = 11.6$; $Me = 13.1$; $Q_3 = 15.2$; range 9.9 to 19.1.

The entire group of 5,000 cases was divided into four subgroups to ascertain whether or not the mean annual perform-

TABLE 1

Showing: D, the Difference between the Means, and D/σ_D, the Reliability of the Difference between the Means. $N = 5000$; $M = 67.6 \pm 0.55$ $\sigma = 38.7 \pm 0.0$; $Q_1 = 35.7$; $Me = 63.3$; $Q_3 = 94.4$; $Q_4 = 204$

	Second 1250 M = 64.8; σ = 37.5		Third 1250 M = 68.25; σ = 37.5		Fourth 1250 M = 69.45; σ = 37.5	
	D	D/σ_D	D	D/σ_D	D	D/σ_D
First 1250 ..... M = 67.65 σ = 37.5	2.85	1.9	0.6	0.4	1.8	1.2
Second 1250			3.45	2.3	4.65	3.1
Third 1250					1.20	0.8

[1] Formerly Psychologist, U. S. Public Health Service.

ances on this test varied significantly. Each subgroup represents the Alpha-examined commitments of approximately one year. Table 1, containing the measures of central tendency and variability of the entire group, shows that the average performance of each of the four subgroups did not (with one exception) differ significantly from each of the others during the experimental period of about four years.

Table 2 contains both the centile rank and the T-score corresponding to any raw score on the *Revised Alpha Examina-*

TABLE 2

Centile and T-scale for the Revised Alpha Examination Form 5 (F. L. Wells, 1932). N = 5000 Adult, Literate, Males

Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score
1	0	14.5	51	39	47.5	101	80	58.5	151	97	69.
2	0	19.	52	40	47.5	102	80	58.5	152	97	69.
3	0	21.	53	41	48.	103	81	58.5	153	97	69.
4	0	23.5	54	42	48.	104	82	59.	154	98	69.5
5	1	25.	55	43	48.5	105	82	59.	155	98	70.
6	1	26.	56	44	48.5	106	83	59.5	156	98	70.
7	1	28.	57	45	49.	107	83	59.5	157	98	70.5
8	2	29.	58	46	49.	108	84	59.5	158	98	70.5
9	3	30.5	59	47	49.	109	85	60.	159	98	71.
10	3	31.5	60	48	49.5	110	85	60.	160	98	71.
11	4	32.	61	49	49.5	111	85	60.5	161	98	71.5
12	4	33.	62	50	50.	112	86	60.5	162	99	72.
13	5	34.	63	51	50.	113	86	60.5	163	99	72.
14	6	34.5	64	51	50.5	114	87	61.	164	99	72.5
15	7	35.	65	52	50.5	115	87	61.	165	99	72.5
16	7	35.5	66	53	51.	116	88	61.5	166	99	73.
17	8	36.	67	54	51.	117	88	61.5	167	99	73.
18	9	36.5	68	55	51.5	118	88	62.	168	99	73.5
19	10	37.	69	56	51.5	119	89	62.	169	99	74.
20	11	37.5	70	57	51.5	120	89	62.	170	99	74.5
21	12	38.	71	57	52.	121	90	62.5	171	99	74.5
22	13	38.5	72	58	52.	122	90	62.5	172	99	75.
23	13	39.	73	59	52.	123	90	62.5	173	99	75.5
24	14	39.5	74	60	52.5	124	91	63.	174	99	76.

TABLE 2—(*Continued*)

Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score	Wells score (Rev.)	Centile	T score
25	15	40.	75	61	52.5	125	91	63.	175	100	76.5
26	16	40.	76	62	53.	126	91	63.5	176	100	77.
27	17	40.5	77	63	53.	127	91	63.5	177	100	77.
28	18	41.	78	63	53.5	128	92	63.5	178	100	77.5
29	19	41.5	79	64	53.5	129	92	64.	179	100	78.
30	20	41.5	80	65	54.	130	92	64.	180	100	78.5
31	21	42.	81	66	54.	131	93	64.5	181	100	78.5
32	22	42.	82	66	54.5	132	93	64.5	182	100	79.
33	23	42.5	83	67	54.5	133	93	65.	183	100	79.5
34	23	42.5	84	68	55.	134	93	65.	184	100	80.
35	24	43.	85	69	55.	135	94	65.5	185	100	80.5
36	25	43.	86	70	55.5	136	94	65.5	186	100	81.
37	26	43.5	87	70	55.5	137	94	66.	187	100	81.5
38	27	44.	88	71	55.5	138	95	66.	188	100	81.5
39	28	44.	89	72	55.5	139	95	66.5	189	100	81.5
40	29	44.5	90	72	56.	140	95	66.5	190	100	82.
41	30	44.5	91	73	56.	141	95	66.5	191	100	82.
42	31	45.	92	74	56.5	142	95	67.	192	100	82.
43	32	45.5	93	75	56.5	143	95	67.	193	100	82.
44	33	45.5	94	75	57.	144	96	67.	194	100	82.
45	34	46.	95	76	57.	145	96	67.5	195	100	82.
46	35	46.5	96	77	57.5	146	96	67.5	196	100	82.
47	36	46.5	97	77	57.5	147	96	68.	197	100	82.
48	37	47.	98	78	58.	148	96	68.	198	100	82.
49	38	47.	99	79	58.	149	97	68.5	199	100	84.
50	39	47.	100	79	58.5	150	97	68.5	200	100	84.

tion, form 5. The limitations surrounding the interpretation of the upper and lower deciles of the centile scale are recognized but this centile scale is more correctly applicable to adult populations, despite its limitation, than are the concepts of the M.A. and the IQ. Although the T-score is applicable, strictly speaking, only to data of a normal curve, these data approximate the normal curve sufficiently well for practical purposes to warrant the application of the T-score method of ranking.

A NEW APPLICATION OF SURVEY TECHNIQUES TO THE STUDY OF PUBLIC ATTITUDES TOWARD CONTRIBUTING TO SOCIAL AGENCIES

WALLACE H. WULFECK

The Psychological Corporation

VOLUNTARY support of agencies organized to care for the incapacitated and indigent has been regarded as one of the prime privileges and obligations of citizenship in a Democracy. Those who define Democracy in terms of individual freedom and initiative believe that governmental assumption of this prerogative tends to restrict the individual's freedom and eventuates in some form of regimentation. Directly opposed to this point of view are those who hold this function to be the direct responsibility of government. Regardless of the economic and social implications inherent in either position, we as a nation, are confronted by the paradox of a so-called democratic laissez faire government gradually assuming more obligation for an increasing share of human welfare. The fundamental tenets of the democratic form of government, once clearcut, are becoming vague and indefinable. Seven years of New Deal policy have produced a political leadership which is muddled and a bewildered public. Without intending to be partisan this statement seeks only to point out the growing inconsistency in current political philosophy. One aspect of the resulting confusion is in part responsible for this study.

In recent years various community chests throughout the nation have encountered serious difficulty in raising the necessary funds for the continuance of participating agencies programs at the level of effective service. The Community Fund in one of our important cities, faced with this dilemma, asked the Psychological Corporation if it could develop a technique

by which the factors contributing to its failures might be extracted from public opinion and attitude. In other words, what determiners are operating in the "public mind" which might bring about reduction and/or cessation of giving toward the support of eleemosynary enterprises.

From the agencies' point of view four fundamental questions are involved: (1) Has the incursion of government into the relief field given rise to the belief that government is responsible? (2) Are there objections to the various participating social agencies or their programs? (3) Are there negative attitudes toward cooperative fund raising methods employed by Community Chests, and finally (4) Is it simply a matter of bad educational method on the part of the fund raising organization?

These four questions really formulate the problem. Public knowledge and attitude are the nub of it. Internal factors such as efficiency of the organization are not pertinent.

Because the problem is related to several fundamental socio-economic questions and because the situation provided opportunity for experimental application of survey techniques to a relatively new area of public attitude, the Psychological Corporation undertook the study. It so happened that the writer had considerable experience in fund raising and was cognizant of many of the technical aspects of the job.

Two experimental approaches were made. The first was an intensive test-tube study covering the four points mentioned above, conducted in one large city. The second was a nation-wide study of one question relating to the place of government in the relief field.

METHOD

In the one city test-tube study, 500 interviews were made among the three highest income levels. The questions asked were designed to cover some aspects of the four phases of the problem mentioned above. Seventy-five per cent of the calls were made with adult men, 25 per cent with women. All interviews were conducted in the home and were made in the

late afternoon and early evening. The lowest income group were neglected because they are more often the recipients of benefits than contributors to such agencies and because the size of the sample imposed necessary limitations.

TABLE 1

Distribution of Interviews

Economic Groups	Men		Women		Total	
	#	%	#	%	#	%
A	18	18.2	32	25.6	100	20.0
B	186	49.6	62	49.6	248	49.6
C	121	32.6	31	32.6	162	30.4
Total	375		125		500	

One hundred of the 500 interviews were made among the A class or highest income group. This tends to overweight the sample but is justified on the ground that the size of the per capita contribution is relatively high at this level. A representative sample was assured by using an economic map of the city based upon the monthly rental rate.

The obtained data were submitted to an exhaustive statistical analysis, by the punched-card method. Only those tables pertinent to this paper are presented here.

The second study, a part of a nation-wide social survey, bears only upon the question of responsibility for financing social agencies. The question used was taken from the first study without change in wording. Six thousand, four hundred fifty-one interviews were made in over 80 cities scattered throughout the United States. Approximately equal numbers of men and women among the four income classes were interviewed as follows: 10 per cent "A," 30 per cent "B," 40 per cent "C," and 20 per cent "D" class. Both questionnaires were pre-tested several times before the final form was adopted.

RESULTS

The discussion of results will follow the order of the four questions outlined above. Although each of these questions has an answer in the data, the first of them will occupy the greatest part of our discussion, since the results have the broadest general interest.

(1) As will be seen in Tables 2 and 3, the confusion arising over the responsibilities of the governed and the government

TABLE 2

One-City Sample

Q. 5. Do you think organizations such as the R. C., Y. M., orphanages and hospitals should be supported by: a) the gov't ——, b) the C. F. ——, c) or should they raise their own money ——? Comments

	Economic Groups			Total
	A	B	C	
	%	%	%	%
Government	14	29	45	31
Community Fund	58	39	20	37
Raise Own	17	22	17	19
Government and Community Fund	1	2	2	2
Government and Raise Own	1	1	6	3
Community Fund and Raise Own	2			
All three	1			
Don't know	6	7	10	8
Total %	100	100	100	100
Total Interviews	100	248	152	500

in a democracy carries deeply into the attitudes of the people. On this one question alone there is little notion of the rightful place and function of the government in the program of relief and institutional aid. The results from both studies are strikingly similar in this respect.

Roughly around 30 per cent of the people now hold the

TABLE 3

Nation-wide Sample

Q. 12. Do you think organizations such as the R. C., Y. M., orphanages and hospitals should be supported by: a) the gov't ——, b) the C. F. ——, c) or should they raise their own money——? Comments

	Economic Groups				Total	
	A	B	C	D		
	%	%	%	%	N	%
Government	16	22	30	42	1858	29
Community Fund	43	35	26	19	1869	29
Raise Own	24	24	23	17	1458	23
Government and Community Fund	3	4	4	4	243	4
Government and Raise Own	1	1	1	1	79	1
Community Fund and Raise Own	4	2	1		95	1
All three	1	2	2	1	88	1
Don't know	8	9	13	16	761	12
Total	100	100	100	100	6451	100

unqualified opinion that support of all social service agencies is the obligation of government.

In the nation-wide study an approximately equal per cent (29) hold public financial support to be a united community duty whereas the one-city study showed 37 per cent sharing this view. About 20 per cent believe each agency should raise its own budget. While 13 per cent in the one city and 19 per cent throughout the nation either do not know who should maintain them or split the responsibility. Clearly enough there is a disturbing lack of unanimity and considerable evidence of confusion. It may be expected that the implications for democracy inherent in the individual opinions which make up this statistic are rarely if ever suspected.

Closer inspection of the tables reveals some interesting details. As we go down the economic scale it is observed that more and more people tend to depend upon the government for the maintenance of social agencies. Conversely the higher

the income level the greater the belief that cooperative public effort should be responsible. Economic status appears to have little effect upon the opinions of those who believe the agencies should finance themselves or believe the obligation to be a joint one.

Dependence upon the state and a tendency toward a belief in more socialized forms of government characterizes very strongly the attitudes of the members of the lower income groups. But by no means is this attitude absent among the middle and upper economic groups. Right or wrong the "let Uncle Sam do it" attitude is becoming the order of the day.

A second question included in the one-city survey throws more light on this tendency. When asked "Do you believe that unemployment and other government relief has made people give more or less to these organizations?" 62 per cent answered "less," 19 per cent "more," 3 per cent "no effect" and 16 per cent "did not know."

TABLE 4

Q. 7. Do you believe that unemployment and other government relief has made people give more —— or less —— to these organizations?

	Economic Groups			Total
	A	B	C	
	%	%	%	%
More	12	19	24	19
Less	73	62	55	62
No effect	3	4	3	3
Don't know	12	15	19	16
Total per cent	100	100	100	100
Total Interviews	100	248	152	500

Broken down by economic groups it may be observed that the higher the income level the greater the belief that government relief programs have caused people to give less to social agencies. Thus the belief that government should finance

such institutions is related to the belief that this attitude affects the size of private contributions to them. More than that, a fair share of those who do not believe it is a government job nevertheless think that individual contributions are reduced because the state has assumed so large a share of the relief load. In this connection it is interesting to note that 61 per cent of the persons interviewed believe the Fund was raised by many contributions of $5.00 or less rather than by a small number of large gifts (Q. 13).[1]

These opinions are perhaps consciously or unconsciously determined by the personal economic status of the respondents when asked (Q. 11) "What do you think happens when they don't get all the money they ask for?"

Many of the people (44 per cent) believe that Agency services are curtailed when the Fund fails to raise its quota. There is, however, a nice distinction which appears between the form of expression which states the foregoing belief for the A economic group and the C economic group. The former tend to express the curtailment in terms of a reduced program, whereas the latter tend to express the curtailment in terms of individual suffering. That is to say, the upper economic level habitually thinks in institutional terms, the lower economic level in personal terms. Perhaps this is due to the fact that members of C economic group are more likely to be potential recipients of agencies' services. A feeling of personal insecurity among the lower income groups may in part account for their attitude of dependence upon the government, while the tax factor seems to motivate the upper economic strata.

All this may seem to be remote from the problems of community funds. But a little thought reveals two important answers for them. (1) One reason for the reduction in contributions to their campaigns stems directly from these attitudes held by contributors. (2) These beliefs, if they continue, may prophesy a profound change in the present form of

[1] The fact is that more than 60 per cent of a quarter of a million annual budget is supplied by 1 per cent of the contributors.

charity and relief programs throughout the country. It may mean ultimate control of all such functions by government and a consequent elimination on shift in the form of the social agencies. This may be a guess far beyond the facts to be found in the data, but the implication is certainly there.

(2) Continuing with the second problem, "Are there any objections to the various participating social agencies or their programs?" several questions were included in the questionnaire to test attitudes toward specific agencies.[2]

This sample of the population gave a negative answer with only negligible exceptions. If this sample represents the general public's attitude it can be said that giving is little affected by feeling against the organizations which participate in the financing efforts of the Community Fund. Religious prejudice, organizational preferences and jealousies did not appear in any significant numbers.

(3) The third problem concerning the existence of negative attitudes toward cooperative fund raising, *i.e.*, the Community Fund itself, again elicited no evidence of crystallized attitudes against the Fund. When asked (Q. 12) "Do you think the Community Fund raises too little or too much?" 12 per cent answered "too much," 35 per cent "too little," 29 per cent "just right" and 24 per cent "did not know."

When non-givers were asked their reasons for not giving (Q. 26) only twelve—10 per cent of 121 non-givers—gave answers which fell into the category "not worthwhile, too much overhead, graft."

Given an opportunity to say why they believed such agencies should be supported by the government, the Community Fund or Raise their own funds (Q. 6) only 24 persons gave replies which directly reflected upon the Fund raising organization.

From these results it does not appear probable that un-

[2] Q. 17. Are there any organizations, *not in* the C. Fund that *should be* in? Yes — No — D. K. — (If yes) Which ones? Are there any *in* which *should not be* in? Yes — No — D. K. — (If yes) Which ones?

Q. 26. (If they gave, ask) How did you decide how much to give last year? (If they didn't give) Why didn't you give?

favorable attitudes toward the Fund seriously affect the size and number of contributions.

(4) Of more importance are the replies to questions bearing upon the effectiveness of the educational and publicity campaign conducted by the Fund.

Recognition of symbols, recall of radio programs and sponsorship, and mail content were tested. Knowledge of campaign goals and results, the number of participating agencies and the character of their work was also explored.

For the sake of brevity the results of these questions may be summarized in the following series of statements:

I Using the recognition method, 27 per cent of the sample failed to identify the widely used Red Feather symbol of the Fund; 21 per cent of the A economic group and 21 per cent of the givers did not remember which money raising organization uses it, although only 5 per cent failed to identify the Red Cross symbol.

II Even though this Fund tries to raise many times more money than any other local effort, only 45 per cent knew that it raises the most. A mere 17 per cent came within a half million dollars of the exact amount when asked how much the Fund tried to raise each year. Only 9 persons named the exact amount ($2,500,000).

III Asked if the most recent campaign was successful, 61 per cent knew that the full amount was not secured. About 15 per cent of these were aware of the extent of the shortage.

IV Although 70 organizations are united in the Fund only 3 per cent had any notion of the number; 29 per cent believed there were less than 40 and 59 refused to guess.

V Asked to name as many of these organizations as they could remember, 36 per cent would not name any, 28 per cent named an average of 5 all in the Fund; 33 per cent named an average of 5 both in and out of the Fund and 4 per cent named an average of 3 all out of the Fund.

VI In the face of an extensive mail budget and several hundred thousand letters and folders mailed annually, only

49 per cent of the contributors and 31 per cent of the non-givers recalled having received any mail at all. Recall of the content was rarely accurate.

VII Local radio programs reach a fair proportion of the people (170—34 per cent) but the script was not tied to the Community Fund in such a way that they remembered who sponsored the programs. Only 5 of 170 listeners identified the sponsors.

In the light of the fact that an intensive educational program is carried on continuously and that the quantity of material and media used is certainly sufficient, these results are somewhat astonishing. The conclusion that the program content has failed to tell the story and make it stick cannot be far wrong. Thus we find the second significant factor to be an ineffectual educational program.

CONCLUSIONS

Two factors appear to provide the major explanations for the lack of adequate financial support of the Community Fund.

(1) The unconditional belief that government should assume the responsibility is shared by 30 per cent of the people questioned. This presages a growing attitude that the state shall become more social in its enterprises to care for the economic welfare of its citizens. In addition there is much confusion as to who is really responsible for financing the social agencies. These two attitudes provide a partial explanation.

(2) Public misinformation and lack of information regarding the aims, ideals, programs, and achievements of the various organizations financed through the Fund and the purposes of the Fund itself also explain its undersubscribed goals.

COOPERATION OF MEN, MANAGEMENT AND PSYCHOLOGISTS IN INDUSTRIAL RELATIONS

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THERE is much novelty in industrial experiences for men, management, and psychologists under present conditions of collective bargaining and labor legislation. The scope of Industrial Psychology and its applications to Industrial Relations have been considerably extended. In the field of vocational selection, the economic and social value of psychological methods has been repeatedly demonstrated during the last three decades. The emphasis and demand for broader application of psychological methods to other problems in Industrial Relations is signified by such publications as "Management and the Worker" (9, 10).

BROAD APPLICATIONS OF PSYCHOLOGY TO INDUSTRIAL RELATIONS

In a recent conference with personnel directors, the following questions were presented as problems to which the Industrial Psychologist is expected to devote his efforts (6, 8):

1. Is it sound practice to introduce a prospective employee to a general picture of the work performed and conditions under which it is performed by actual visit?
2. It has been stated that four out of five people going to work in the morning wish that they were going somewhere else. What can be done to change this condition?
3. How should management deal with chronic complainers, especially when these people are old employees (11)?
4. What is the answer to the ever-increasing problem of educated youth being the understudy of the "old timer" with the idea that one day this youth is to replace this older foreman or supervisor (5)?

5. What is the usual attitude of the employee towards the employer (15)?

6. What psychological factors, if any, assist in explaining the growth of unionism in the United States in the past five years?

7. Why do many employees have the feeling that the boss is always trying to "trim" him even though the policy of the company is contrary to this idea?

8. What practical contributions have Industrial Psychologists made to the handling of employee grievances?

9. What are the advantages and disadvantages of guaranteeing an employee his job? Do the advantages outweigh the disadvantages and how can a job be guaranteed?

10. Has psychology in Industrial Relations been developed to such a point that industry can rely solely on psychological tests for employment of help?

11. How can the degree of "stick-to-it-iveness" possessed by a job applicant be accurately ascertained?

DEVELOPMENT OF PSYCHOLOGICAL METHODS THROUGH COOPERATION OF MEN, MANAGEMENT AND PSYCHOLOGISTS

These Industrial Relations problems and many others are more likely to be dealt with by cooperative efforts of men, management and psychologists. As an illustration of the function of the psychologist in the current problems of Industrial Relations, a program undertaken in a coke plant employing less than 500 men will be briefly reviewed. Up to a short time ago the relationship between employees and management was relatively informal. Employee morale has been fairly satisfactory.

Recently the plant employees joined a union. Turn-over in this organization is small. Hiring is at a minimum. Labor supply is local. Changes in personnel by way of transfer, promotion, or reassignment are few. There are only a few men on one type of work.

Is there really anything further to do about personnel in this organization? If we examine the situation from a broader

point of view, there is a problem of helping employees to understand their various relationships to the organization and to develop mutually desirable standards for work. Such standards should be objective, fair, and based upon sound scientific principles of human relations. Furthermore, in discussion of such matters in the Joint Committee Meeting, the men became interested in the possibility of a Qualifying Examination in the procedure for promotion and reassignment of employees, especially for operating jobs.

The operator's work in a coke plant is an important job. This is considered a good promotion. Operators are key men in the manufacturing and chemical processes and in control of equipment. Many factors concerning production costs, interruption of service, accidents, and improvement in operation are within the control of this group.

A man on this job needs a combination of abilities which is unusual in terms of safety in operation and responsibility. It is a much more difficult type of work than production, because of the need for coordinated thinking and action at crucial moments.

Before a Qualifying Examination could be developed it was necessary to make a detailed analysis of the job. In undertaking such a job analysis, the psychologists were fortunate in having the splendid cooperation of the men in the plant. Through such mutually interested associations, it was possible not only to obtain more accurate descriptions of the job but also to facilitate the development of other personnel procedures (1).

The job descriptions were prepared in simple language and in expressions used by employees. The statements of the job analysis were carefully reviewed with the employees in small groups and individually approved by them. This material later became part of a special *Manual of Job Duties.*

The significant aspect of this job analysis program is the spirit of cooperation which resulted from practical collaboration. The men felt a first hand responsibility in seeing that the job analyses were accurate. Twenty-four representative

employees actually have their signatures printed with this material to indicate full approval. The manifold importance of encouraging employees to analyze their own jobs and to describe their duties in detail is obvious. From an industrial relations standpoint, the first practical step in developing this cooperation was to begin with collaboration of men, management and psychologists.

With such simple but nevertheless accurate descriptions of jobs and essential abilities, it was then possible to consider a special type of qualifying examination. Here again the method was to collaborate with the employees at every step. *To the extent that employees participate in developing personnel procedures, to that extent are such methods likely to achieve their long-term objectives.*

This Qualifying Examination was developed with full recognition of industrial relations needs in this plant in 1939. Every personnel procedure was defined practically in terms of the work to be done and the actual situations or things related to the man on the job. The preparation of the examination was discussed with a number of employees and supervisors. They made many helpful suggestions. Some of them even constructed sample questions. A draft of the examination was submitted for comment and review to the men, supervisors, and members of the Joint Committee.

This form aims to measure mental alertness and adaptability in practical situations. It is not to be confused with the popular conception of an intelligence test. The ability to understand and interpret practical situations and to carry out instructions is basic and seems to broadly differentiate these men for various types of jobs.

Performance in the examination does not depend on formal schooling. Since there is no time limit, the men are afforded the best opportunity to demonstrate their ability. It requires only the ability to read simple material similar to that used in plant instructions. The first form of the examination includes a series of pictures and practical situations likely to be familiar to employees and applicants. It is in the language and envi-

ronmental terms familiar to this type of workman. To adult men in this type of work the situations in the Qualifying Examination are real, and they represent the kind of ideas they use and the things they have to deal with in demonstrating their daily as well as long term effectiveness on the job. The second part of the examination calls for certain types of simple knowledge, ability to understand instructions and ability to make simple records.

Improvement in one personnel technique often has favorable effects on other procedures or methods in industrial relations. Recently this program was reviewed in a conference (1) and the following excerpts are of interest because they indicate the broad implications of an approach to the development of precision and scientific personnel methods:

> "The benefits derived from the foregoing may be summarized in order of relative importance somewhat as follows: 1. inspiring confidence, 2. stimulating interest, 3. providing job and safety information, 4. supplying examination material, 5. providing a test of the accuracy of the employee named, 6. producing a better understanding of the coordinated operation of the whole plant, 7. enhancing the appreciation of the importance of the individual in his job, 8. describing the qualifications of the man necessary for the job, 9. exchanging ideas relative to the job, 10. broadening the education of supervisors, 11. recording departmental vocabulary and vernacular, and 12. furnishing a sound base for a program for the selection and training of plant operators. . . .
>
> "It should be recognized that this material might serve as a pattern or guide for another gas company, but another gas company would need to develop its own specific material. Each group of employees and each plant layout, while similar in many respects, is so individual in character that serious difficulties would be encountered if a perfunctory adaptation of the material were attempted. Our experience indicated the wisdom of having job analyses made by competent outsiders working with the regular operators. Without the time and help given by the twenty-four regular operators in the six departments this work could not have been done in its present form."

PSYCHOMETRIC METHODS AND INDUSTRIAL RELATIONS

Men, management, psychologists and engineers have also been devoting considerable attention to the current problem of more accurately describing and evaluating jobs and their relative worth in terms of points and wages (4).

> "Research on this subject involves analyzing the qualities required to do the work in question. By careful thought and discussion, it can be decided what kinds of skill, endurance, knowledge and experience are needed to do the work in question. As far as possible, the words and phrases used to describe the qualities should not overlap or conflict with one another. Usually a sentence or two describing each quality chosen and perhaps illustrating that quality will help very much at later stages in the research. . . .
>
> "Bear in mind also that those who work on and those who supervise the operations in question can give substantial aid. Your primary concern here is to test and demonstrate a form of research as a useful tool. Do not fall into the common error of trying to impose your will on the lives of others. Even though in some analyses and research it is felt that little help can be gained from those closest to the jobs, it must be remembered that for the plan to get into use, it must be well understood and felt to contain the best informed judgments on the subject" (16).

Here as in many other fields of industrial relations, ample theory seems available but practical research results are still forthcoming. It is in this area perhaps that during the next decade the psychologists can contribute much by the use of available statistical methods and the extensive research on scaling methods (7).

Other common problems in industrial relations should not only be measured but should be psychologically correlated as shown in the "Outline of Some Measurable Factors in Industrial Relations." For some of these problems, methods have been demonstrated. For others, the critical methods will be forthcoming when men, management and psychologists cooperate in a common effort (12, 13, 14).

OUTLINE OF SOME MEASURABLE FACTORS IN INDUSTRIAL RELATIONS (2)

1. Fitness for work	Age, education, experience.
	Interests.
	Emotional stability.
	Intelligence.
	Strength and health.
	Special aptitudes and talents.
2. Training	Progress in learning, kind of training available and methods in use.
3. Supervision	Methods and attitudes of supervisors.
4. Organization of work	Layout, routing, supply of materials.
	Work methods, tools, machines, postures, variety of work.
5. Hours of work	Rest pauses, variations in production, work curves.
6. Work conditions	Lighting, ventilation, noise.
7. Physical fitness	Food, sleep, relaxation.
8. Financial incentives	Salary, wages, fairness of rate.
	Method of payment: day wage, group bonus or piece rate.
9. Non-financial incentives	Supervisory methods, production records, merit ratings.
10. Opportunity for advancement.	
11. Uncertainties concerning accidents, health hazards, old age, and unemployment.	
12. Satisfaction, contentment and life outside working hours.	

Industrial psychologists have at hand many techniques, as described in publications by Tead (17), Bingham (3), Uhrbrock (18), and Viteles (19). The task for men, management and psychologists is to make greater use of the practical experiments in studying industrial relations problems.

This paper has reviewed a program of cooperation in industrial relations research of men, management and psychologists. A new method means essentially an experimental attitude. This necessitates a pioneering and courageous approach in dealing constructively with mutual problems.

The psychological method is one scientific and experimental point of view in industrial relations. It provides codified standards and facts in human relations.

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IDENTIFICATION OF THE OCCASION AS A FACTOR IN LEARNING

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DOES designating to the learner the occasion upon which he is regularly to perform a given task increase the likelihood that he will the sooner learn to do so upon his own initiative? Or will he learn just as soon or sooner if he is merely instructed over and over again at the appointed times without vocally being made aware of the occasion?

For instance very often a child has to acquire the habit of taking medicine after or before a meal. How soon will he learn to do so if the parent instructs him on the necessary successive occasions upon which he gets through with his meal, "Son, remember to take your medicine just as you get through with your meal." Then comparatively, how soon will he learn to do so if the parent's instruction upon the same successive occasions consists only of this statement, "Son, take your medicine, please."

In a more general way the question is how comparatively efficacious is the simultaneous occurrence of the so-called adequate and inadequate stimuli when the adequate stimulus is identified for the learner and when it is not.

Twelve kindergarten children were given instructions individually according to the former pattern and twelve according to the latter. The investigation extended over a period of three years as our facilities permitted the use of only two children at a time. Also the same situation and the same performance could not be used with all the twenty-four, so the endeavor was made to pick occasions equally regular and equally obvious to the children, and responses equally interesting, or rather uninteresting; for in an effort to use responses of equal interest it was felt best to use those that had no or little import for children.

The occasions used were: (a) taking a drink in line with other children at a regular time in the day; (b) taking off one's wraps after coming in from outdoor recess; (c) putting away one's blanket after taking a rest; (d) washing one's hands after a regular visit to the toilet. The responses were the following: (a) getting a book from a shelf and giving it to the assistant teacher; (b) getting a dish from a shelf and giving it to the assistant teacher; (c) getting the attendance cards and giving them to the regular teacher; (d) getting the unused paper towels and giving them to the assistant teacher.

One of the two contrasting sets of instructions will now be given in detail as an illustration. The assistant teacher standing near the given subject of the experiment said to him the moment he finished taking his drink, "John, every day from now on just as you get through with your drink, I want you to get that book on the shelf and bring it to me." The first day the instructor showed where the book was. On the next day at the same moment the instructor waited for a flash of a second after the child was through with his drink to see whether he would get the book on his own account. Just the second she saw he was not going to do so she repeated exactly the sentence above. This same alternative behavior upon the part of the teacher was repeated each day until the child performed the task upon his own initiative five days in succession. With the second subject the instructor did exactly the same except to say, "John, will you please get that book on the shelf and bring it to me."

When any subject made the given response five days in succession without being reminded, he was considered as having learned it and the experiment stopped as far he was concerned. Of course the subjects often performed the act two, three, and even four days in succession and then had to be reminded again, and the effort to train had to be continued.

The best single measure of the respective amount of training necessary in the two types is probably the central tendencies of the number of days together that subjects were reminded of the task and did it of their own accord before beginning the five successful days. This would be the best measure in spite of the fact that two children who were trained by having the occasion indicated to them and six or one-half of those trained by the other method passed out of our control before they ever did do the task five days in succession upon their own initiative. Most assuredly if the two and six children had been held until they finally did succeed, the results would have been far less favorable for the second method than the figures show.

For the group trained by indicating the occasion the mean number of days was 16.58 ± 2.12. For the other group this figure was 33.67 ± 4.14 days, over twice as long. The difference between these two means was 4.8 times its probable error. The median score for the first group was 15, for the latter between 33 and 40.

From these data it seems clear that designating for the learner the occasion upon which a given act is to be performed will greatly decrease the time it will take him to learn to do it upon his own accord in comparison with designating merely the act to be performed. It should also be said that these data put a strain upon our belief in the association theory, namely that a response is attached to an inadequate stimulus by the repeated simultaneous occurrence of the adequate and inadequate stimuli

followed finally by the withdrawal of the former as the latter becomes capable of taking its place.

Some further figures and observations may be in order. The range of learning days for the first group was from two to 45 days and for the second group four to 75 days. Accordingly some children learned strikingly sooner than others. Why so few repetitions for some learners and so many for others? These figures confirm the conclusion that the mere repetition had little comparative effect upon the ultimate success.

Nor was general intelligence much of a factor. Indeed the correlations between intelligence and quickness of learning for both groups were slightly negative, $-.246 \pm .18$ and $-.25 \pm .18$ respectively. The reasons for this appeared to be the children's deeper interest in other things going on in the room and their almost total lack of interest in the assigned task. Moreover, these factors seemed to be slightly more operative with the bright children.

NEWS AND NOTES

The Eastern Association of College Deans and Advisers of Men held its eleventh annual meeting on Saturday, November 25, 1939, at Haddon Hall, Atlantic City, New Jersey, with President Frank G. Lankard, Brothers College, Drew University, acting as chairman. The problem of discipline in the college was the general theme of the meeting.

The fourth annual conference on Vocational and Educational Guidance of the National Institute of Industrial Psychology was held at University College, London, England, on January 8. One of the sessions was devoted to a discussion of the new Terman-Merrill revision of the Binet-Simon tests of intelligence. At the conclusion of the discussion a committee, under the chairmanship of Professor Burt, was appointed for the purpose of producing a British standardization of the Terman-Merrill revision. The suggested version has since been drawn up and is now in process of standardization.

The new Diagnostic Examination of Silent Reading Abilities by August Dvorak and M. J. Van Wagenen consists of ten parts. Parts 1–5 are measures of verbal competence; the second function of the test is in parts 6–10, which are expressions of reading performances. The third function is that of analysis or diagnosis and consists of a study of the results of all ten of the parts. Parts 6–10 occupy two-thirds of the testing time of two hours. The two hour length of this test is a marked departure from the recent emphasis upon speed. The test analyzes reading ability into the following separate elements susceptible to remedial teaching: rate of comprehension; ability in perceiving relationships; vocabulary, both words in context and isolated words; range of general information; grasping central thought; retention of clearly stated details; integration of dispersed ideas; drawing inferences from context; and interpretation of contents. The test is published by the Educational Test Bureau, 720 Washington Ave. S.E., Minneapolis, Minn. A new feature of the test is that it is adapted to machine scoring.

A new book entitled "Intelligence and Crime," by Simon M. Tulchin, is the result of an eleven-year study of 10,413 Illinois penitentiary and reformatory prisoners, recently published by the University of Chicago

Press. Dr. Tulchin, formerly a psychologist for the Illinois Institute for Juvenile Research, found that the average criminal is as intelligent as the average soldier, but no more so. Intelligence or lack of it does not explain why an individual becomes a criminal, but it is a determining factor in his choice of a crime specialty, according to Dr. Tulchin's findings. Many other interesting facts are discovered and related by the author.

California has had in effect since 1909 a sterilization law applying only to inmates of state institutions. Up to the present time the state has sterilized about 12,600 patients. The Human Betterment Foundation has for years been making an intensive study of the results to the patient, the family and the community. For further details see "Human Sterilization Today," or write The Human Betterment Foundation, 321 Pacific Southwest Building, Pasadena, California.

The Michigan Vocabulary Profile Test, prepared under the direction of Edward B. Greene, Department of Psychology, University of Michigan, gives a profile of a student's vocabulary in eight fields of information as follows: Human Relations, Commerce, Government, Physical Sciences, Biological Sciences, Mathematics, Fine Arts, and Sports. Each division of the battery consists of thirty items arranged in ten levels of difficulty. It has been said that "terminology in any subject is more than a mere list of words; it is a catalogue of the important concepts in that subject." The test is self-administering and scoring is by simplified stencil, or by machine. The World Book Company is the publisher.

The Sixth Institute on Exceptional Child was held at Langhorne, Pa., November 24, 1939, under the auspices of the Child Research Clinic of The Woods Schools. Authorities in the fields of the exceptional child, psychologists, psychoanalysts, research directors and educators were among the speakers on the program. Speaking on "The Interplay Between Emotional and Intellectual Level," Dr. Bruno Klopfer, Director, Rorschach Institute, New York City, reviewed the history of the Rorschach Method and its position among the different approaches to personality study. Dr. A. Irving Hallowell, University of Pennsylvania, spoke on "The Child, The Savage and Human Experience." One of his conclusions was that there are some similarities between children and primitive peoples but that the facts do not bear out the theory of similarity of development in the individual and in the race.

Other speakers and their topics included Dr. W. E. Blatz, Director of the Institute of Child Study, University of Toronto, who spoke on "What Is an Exceptional Child?" Dr. J. Louise Despert, Payne Whitney Psychiatric Clinic, New York Hospital, spoke on "Research in the Nursery School"; and Dr. Charles M. Morris, Resident Psychologist, The Woods Schools, Langhorne, Pa., discussed "A Special School Looks at Special Education."

"If you counsel, advise on job-hunting, direct a guidance program, administer vocational tests, manage a placement bureau, supervise personnel service, teach an occupational class, conduct guidance service in clubs, Y.M.C.A.'s or Y.W.C.A's, address a group on the subject of occupations, or head a library, you need the *Vocational Guidance Digest.*" The foregoing statement appears in an announcement sent out by the Stanford University Press concerning this useful publication which is now beginning its sixth volume, under the editorship of L. R. Martin. Guidance experts on the editorial advisory board of the *Digest* include Walter J. Greenleaf, Specialist in Occupational Information and Guidance, Office of Education, Washington, D. C.; C. Gilbert Wrenn, Research Adviser, General College, University of Minnesota; Harry E. Tyler, Sacramento Junior College; Curtis H. Threlkeld, Principal, Columbia High School, South Orange, New Jersey; Robert C. Cole, Director of Guidance, Worcester Boys' Club, Worcester, Mass.; and Margaret E. Bennett, Director of Guidance, Pasadena City Schools, Pasadena, Calif. The yearly subscription rate is $2.50.

BOOK REVIEWS

PRATT, CARROLL C. *The Logic of Modern Psychology.* Macmillan, pp. 179, $2.

This review can well start with a quotation from page 147. "It must be obvious to the reader, however, that these pages, except for a few comments later, are not concerned with applied psychology." This statement should not prevent the applied psychologist from making this book some concern of his.

The main thesis of the book is that care must be exercised in generalizing from observable data, that is in the construction of theories, concepts, principles, laws. Although there is some logic involved in selecting what is to be observed, Professor Pratt explains that the gross errors occur at this level very infrequently. It is much more difficult to go forward from observed data and give a description of the events that involves no error. Descriptions or reports necessitate the use of symbols and these are not always well standardized. But it is futile to make observations and do nothing about the data. Of course it is permissible to go beyond the data and thus exercise a formal as well as a material logic. However, there should be some control on this process of building principles and it should not be allowed to get far from the data of observation.

It is shown that philosophy and science are constantly overlapping and cannot be kept discrete.

The author has something to say about the logic used by several of the accepted leaders in psychology and it is astonishing to find how well the quotations from these sources illuminate the main trend of thought herein.

Since the primary data of observation are relatively useless and unimportant, it is shown by example how to construct a formal physiology, psychological physiology, to correlate these data. Although a formal physiology is not as good as a material physiology, in the absence of the latter, psychologists are justified in using the former.

As illustrations of points along the way, many experiments are cited, from rats and reflexes to tonal densities and key pushings.

Not the least surprising aspect of this book is the delightful style in which the subject is treated. It carries a "lesson" and exemplifies good teaching technique. No doubt Professor Pratt is a "born" teacher; *cf.* p. 175. The book can be read with profit by all psychologists, "pure" and "applied" alike.

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BLUEMEL, C. S. *The Troubled Mind.* 1938. ix + 520 pages. Baltimore: The Williams & Wilkins Co.

The subject of the book is the disturbed and troubled normal human being rather than the pathologically abnormal individual, although all the important psychiatric categories are discussed. Particular attention is given to the psychopath-at-large, with special reference to the social implications of the psychopath's participation in politics. But this emphasis by no means describes the contents. The book is replete with all types of cases of human maladjustment. Whether the topic is fear of dirt or fear of insanity; excessive sweating or air hunger; stuttering or hysterical blindness—the psychologist's interest is easily maintained, for the author deals with personalities daily encountered in psychiatric practice. Some of the peculiarities of behavior which are reported will prove astounding even to the sophisticated instructor of abnormal psychology who may find it worth while to include such source material in his daily lectures and discussions. It is of interest that Dr. Bluemel gives little attention to psychoanalysis. Nowhere does he discuss the topic and his few remarks about it suggest that he questions its value.

The case studies are devoted to description rather than to interpretation. They average about ten lines in length and do not always satisfy the reader's curiosity about etiology, prognosis, and treatment. The lack of criteria for differential diagnosis and the loosely organized presentation are other shortcomings. But the emphasis upon content rather than system is justified by the gaps in our knowledge of human behavior.

The advantages of the book are far more imposing than its disadvantages. A fact of considerable importance is the author's psychological orientation as revealed in his evaluation of the effects of learning. The book is a contribution to clinical studies of human behavior.

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Rochester, New York

CHESTER ROY GARVEY. *The Activity of Young Children During Sleep.* Minneapolis, University of Minnesota Press. 1939. Pp. x + 102.

This monograph analyzes the records of 3,486 nights' sleep of 22 children between the ages of 25 and 58 months. Each child slept in his own home in a special bed to which was attached H. M. Johnson's apparatus for recording movements of the bed springs. In all essential details Johnson's method was followed so that the results could be compared with his on adults.

The mean rest period of all children was about 8 minutes and they took about half an hour to go to sleep. Thus the children were found to be about twice as active as adults. Plotting the number of moves against the

time since going to sleep showed a rhythmic curve of sleep which was very similar from child to child in contrast to the individual variations found with adults. Quieter sleep was found with boys, if the children did not have a nap, with medium temperatures, at ages two and four, in February and March, when the bed was wet, when the children had played violently before bed time, and when sleeping on the back or abdomen. Quietness of sleep was not related to length of sleep, time of going to bed, attendance at the nursery school the preceding day, room or outside temperature, or weight or body build. None of the data upon which these statements are based showed very pronounced differences from their opposites.

This study is an interesting addition to the literature on sleep, but the delay in its publication weakens its effectiveness. The date of publication is just 9 years and 26 days later than the last day of observation. According to a foreword by J. E. Anderson, the author was engaged in preparing this monograph for publication when he died. The staff of the Institute of Child Welfare saw the book through the press. There have been only minor changes from the material left by Dr. Garvey. In a sense this is unfortunate. A delay of nine years in preparing a monograph of this size for publication was hardly necessary. If Dr. Garvey had completed his manuscript he surely would have given some recognition to work later than 1931 which is the date of the latest reference in his bibliography. For the editors to publish this work as though it were very recent and the latest investigation in the field, without any direct indication of its age, is unfair to the reader and to the author.

C. M. Louttit,
Indiana University

NEW BOOKS AND PAMPHLETS

New books and pamphlets for review should be sent to JAMES P. PORTER, *Editor*, JOURNAL OF APPLIED PSYCHOLOGY, Ohio University, Athens, Ohio.

Abstracts of Dissertations, University of Southern California Press, Los Angeles, California, 1939. 146 pp.

Annual Report of the Neuro-Psychiatric Institute of the Hartford Retreat. Hartford, Conn. 44 pp.

Annual Report of the Superintendent of the Ohio State School for the Blind. Columbus, Ohio. 101 pp.

Dynamic Forces in Elementary Education, Special Number. Muskingum College Faculty News Bulletin, November, 1939. Lorin E. Bixler, Editor. Muskingum College, New Concord, Ohio. 16 pp.

Guidance in Public Secondary Schools. ARTHUR E. TRAXLER. Educational Records Bureau, 437 W. 59th Street, New York City, 1939. 329 pp.

Improving Your Personality. EARL C. LOCKHART. Walton Publishing Company, 332 S. Michigan Avenue, Chicago, Ill., 1939. 512 pp.

The Individual and His Society. ABRAM KARDINER. Columbia University Press, New York City, 1939. $3.50. 503 pp.

Objective Personality Study. EMILY L. STOGDILL AND AUDELL HERNDON. Longmans, Green & Company, New York, 1939. $1.00. 106 pp.

Proceedings of the Midwestern Forum on Visual Teaching Aids: Chicago, May 12–13, 1939. The Educational Screen, Chicago, Ill. 50 cents. 79 pp.

Propaganda Analysis, Vols. I and II (1938 and 1939). Institute for Propaganda Analysis, Inc., 130 Morningside Drive, New York City. 1938. $1.50 each.

Psychological Issues. ROBERT S. WOODWORTH. Columbia University Press, New York City, 1939. $3.50. 421 pp.

Speech Development of a Bilingual Child. Vol. I. WERNER F. LEOPOLD. Northwestern University, Evanston, Ill., 1939. $2.25. 188 pp.

Students' Manual for General Psychology. W. F. VAUGHAN AND I. G. NEEDHAM. Doubleday, Doran & Company, New York City, 1939. 238 pp.

A Study of Jealousy. T. M. ANKLES. Bruce Humphries, Inc., 306 Stuart Street, Boston, Mass., 1939. $2.00. 109 pp.

Textbook of Abnormal Psychology. ... Second Edition. ROY M. DORCUS AND G. WILSON SHAFFER. Williams & Wilkins Company, Baltimore, Md., 1939. $4.00. 475 pp.

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(*Continued*)

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